Per
U
I
N34

NAVY CIVIL ENGINEER

WINTER 1972

CALIFORNIA STATE UNIVERSITY,
NORTHRIDGE LIBRARY

MAR 15 1973

CALIFORNIA STATE UNIVERSITY
NORTHRIDGE LIBRARY

MAR 8 1973
419-B
DEPOSITORY

Results of Readers Survey

PAGES 28-29

ON THE COVER

Indicative of both the winter season and the close working relationship of the Naval Facilities Engineering Command with the construction industry the cover portrays the traditional placement of a Christmas tree on the final structural level completed by the iron workers. The Command appreciates its rapport with this industry and particularly the support of labor and management during 1972 for their exceptional participation in the Seabee Memorial and Scholarship Fund.

IN THIS ISSUE

The Bolling/Anacostia Master Plan 4
By LTJG W. H. Spell, CEC, USN

VIBRA-LO ... Locomotion Is On The Skids 7

A Cleaner Pensacola Bay 8

Power Electronics 9
By LCDR Thomas W. Moody, CEC, USN

Engineer Registration 11
By LCDR James Doebler, CEC, USN

Quick Camp — Portable Structures 14

Planner and Estimator Development 15
By Bernard T. Lewis, P.E. and LTJG John C. Picco, CEC, USNR

Conservation of Energy 18
By J. R. Koeller

On Advice Of Counsel: Innovative Procurement 20
NAVFAC Counsel Staff

ABFC System and Logistics Planning 21
By LCDR T. J. Heffernan, CEC, USN

Seabee Overhaul of Nuclear Power Plant 22
By EOCS Edwin D. Groover, USN

Antarctic Diesel Power Plant Inproved 23
By J. N. Agnos

The Navy's Hypervelocity Wind Tunnel 24
By CDR Hugh Crisp, CEC, USN

New BEQ in '72 26

Revitalizing A Cambodian Port 27
By LCDR G. R. Gilmore, CEC, USN

The Navy Civil Engineer, Readers' Evaluation 28

Index to The Navy Civil Engineer, 1972 30

Issuance of this periodical approved in accordance with Department of the Navy Publications and Printing Regulations, NAVEXOS P-35. It does not alter, amend or supersede official regulations, orders or directives. Cost of printing is charged by appropriated funds for maintenance and operations of the Naval Facilities Engineering Command.

Published monthly, The Navy Civil Engineer is intended for the information of Regular and Reserve personnel of the Civil Engineer Corps, United States Navy.

Contributions, comments and criticisms from readers are welcomed. Original manuscripts are particularly invited. Opinions or suppositions expressed by authors are solely their own and do not necessarily reflect command or official concurrence. An inquiry should be directed to the Editor prior to submission of material to prevent duplication and to aid in publication planning. The Editor reserves the right to condense accepted material or to complete minor alterations without author consultation. Material appearing in The Navy Civil Engineer may be reproduced. It is recommended that prior to reproduction an inquiry be made to the Editor for additional data that may have become available.

All material accepted for publication by the Editor becomes the property of the U.S. Navy without recompense to the originator.

Correspondence and manuscripts should be addressed to:

The Editor
The Navy Civil Engineer Magazine
Code 19
U.S. Naval Construction Battalion Center
Port Hueneme, California 93043
Tel.: (805) 982-4311

This periodical is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20401. Price 30c per copy. Subscription: $3.50 annually for domestic subscribers; $4.50 annually for foreign subscribers. Send remittance to the Superintendent of Documents.

NAVY CIVIL
ENGINEER

The United States Navy
CIVIL ENGINEER CORPS
and the
FACILITIES ENGINEERING
COMMAND
Washington, D.C.
WINTER
1972
VOL. XIII, NO. 9-10-11-12
(NAVFAC P-330)

WALTER M. ENGER
Rear Admiral, CEC, U.S. Navy
Chief of Civil Engineers
Commander, Naval Facilities
Engineering Command

A. R. MARSCHALL
Rear Admiral, CEC, USN
Deputy Chief of Civil Engineers
Vice-Commander, Naval Facilities
Engineering Command

Regional Editors

Chesapeake Division—Lewis B. Rogers; Northern Division—William M. Carty; Pacific Division—Seymour Francis; Southern Division—Traynor Ferillo; Western Division—CDR Robert J. Westberg.

Special Correspondents

ACB-1, Coronado, California—LTJG William P. Osborne; CECOS, Port Hueneme, LCDR Warren M. Bell; Davisville—S. G. Payne; Guam—Mrs. Glenda M. Wood; Gulfport—Harold K. Braun; NAVSCON, Port Hueneme—ENS Randall Bell; NCEL, Port Hueneme—Jerry Thomas; Newport, R.I.—CDR R. A. Bowers; Pensacola—CDR R. W. Auerbach, Jr., San Diego—Gerald Boling; Subic Bay—LCDR D. Reeves; Vietnam—Dan Doherty.

HAROLD WELSH
Editor

CHARLES W. MATTHEWS
Associate Editor

WILLIAM E. BRACK
Contributing Artist

NOTICE

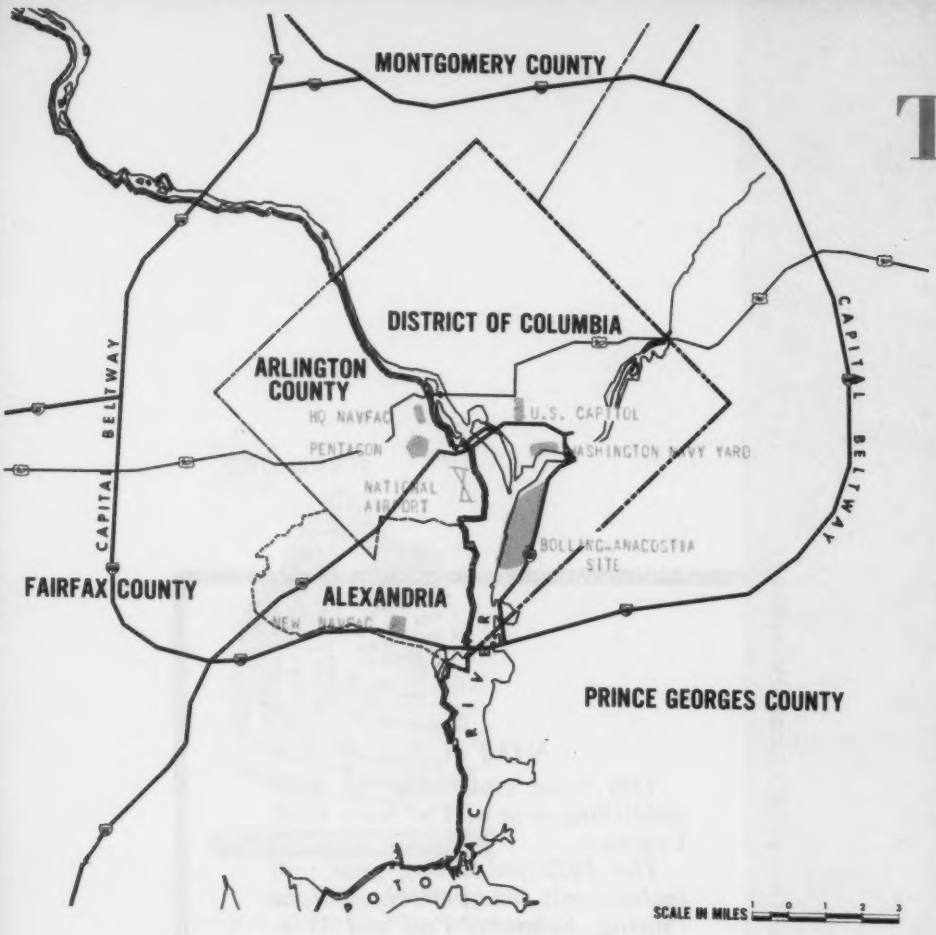
This issue concludes the 1972 publishing year of The Navy Civil Engineer.

The 1973 publishing year will include only *the quarterly editions (Spring, Summer, Fall and Winter) of the publication.*

Monthly news digest editions of The Navy Civil Engineer *previously published are now discontinued.*

The Bolling-
MASTER

By LTJG W. H. SPELL, CEC, USN



Bolling-Anacostia locale in reference to other facilities within the District of Columbia emphasizes its desirability as a site for concentrating Department of Defense activities.

• Washington, D. C.

One mile due south of the United States Capitol is a parcel of urban real estate unique to any other large tract of land in Washington. The site is commonly referred to as the Bolling/Anacostia tract, and is comprised of Bolling Air Force Base and the one time Anacostia Naval Air Station. Situated in the southeast portion of the District of Columbia, this tract of some 1,000 acres is, for the most part, undeveloped. Because of this and the economically depressed area that adjoins it, the Department of Defense and the District government have each been interested in initiating development of various types for years. The Bolling/Anacostia Tract was first used by the military in 1863 when its owner, George Washington Young, leased the property to the U.S. Army for a cavalry depot. In 1917 and 1918, the tract became an official landing field for the air service of the Army Signal Corps, and the Naval Air Station/Anacostia was also established.

President Dwight D. Eisenhower in 1958 requested the Department of Defense to report on future use and military requirements of Bolling/Anacostia, and the following year, the airfields were closed and reductions of military holdings in the area were proposed.

The Air Force requested to retain only 170 acres, and the Navy, 180 acres, thus leaving the National Capital Planning Commission to assume responsibility for urban renewal of 580 acres.

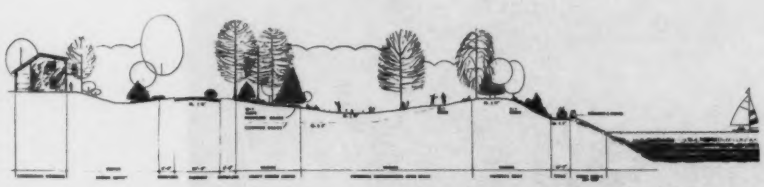
Two years later, however, the Senate Armed Services Committee suggested joint military use of the tract, and in the following year, in 1962, the Air Force produced a joint use plan for 620 acres.

From Nowhere to Limbo

Since that time, several master plans have been completed, but controversy over who should control development of the site has always produced some sort of stumbling block. In 1972, however, progress was realized when the National Capital Planning Commission approved the Department of Defense National Capital Regional Plan, (see Summer Edition 1972) opting to defer final approval of that portion recommending retention of Bolling/Anacostia until they could review a comprehensive master plan for the tract, and until an executive decision had been aired as to the tracts' final disposition. So, for the past fourteen years, the tract has existed in a limbo awaiting a firm decision.

Multitudes of problems have plagued Bolling/Anacostia, some inherent to the site and others forced upon it. Physical isolation is probably the most prominent problem and the most obvious. Even though the area is tied into a major arterial highway system, which gives the advantages of easy accessibility, it has tended to be cut off from its immediate neighbors in the city.

The Potomac River completes the isolation on the other extremity stretch-



Section drawing of a typical park

g-Anacostia
ER PLAN

Three-wing defense office building (center) is intended as the focus of numerous administrative centers for which the complex is designed.

ing over three miles along the western edge of the tract. This aspect on the river side is a very desirable feature, however, to be looked upon as an asset rather than a liability. Where in any major city can one find such an extensive amount of riverfront in an undeveloped state? The riverfront atmosphere will provide numerous complements to any development on the site.

Because a large part of the land is composed of varying types of fill, construction techniques are difficult. The topography of the site further reinforces the isolated characteristic as there is a considerable grade differential running longitudinally along the eastern boundary.

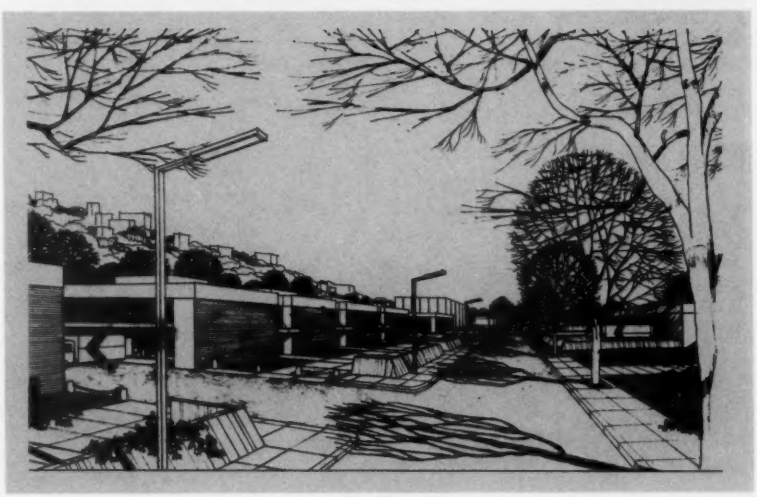
Directly across the river is National Airport, one of the busiest in the country.

Finally, the section of the city in which the site is located happens to be less prosperous and is burdened with social ills.

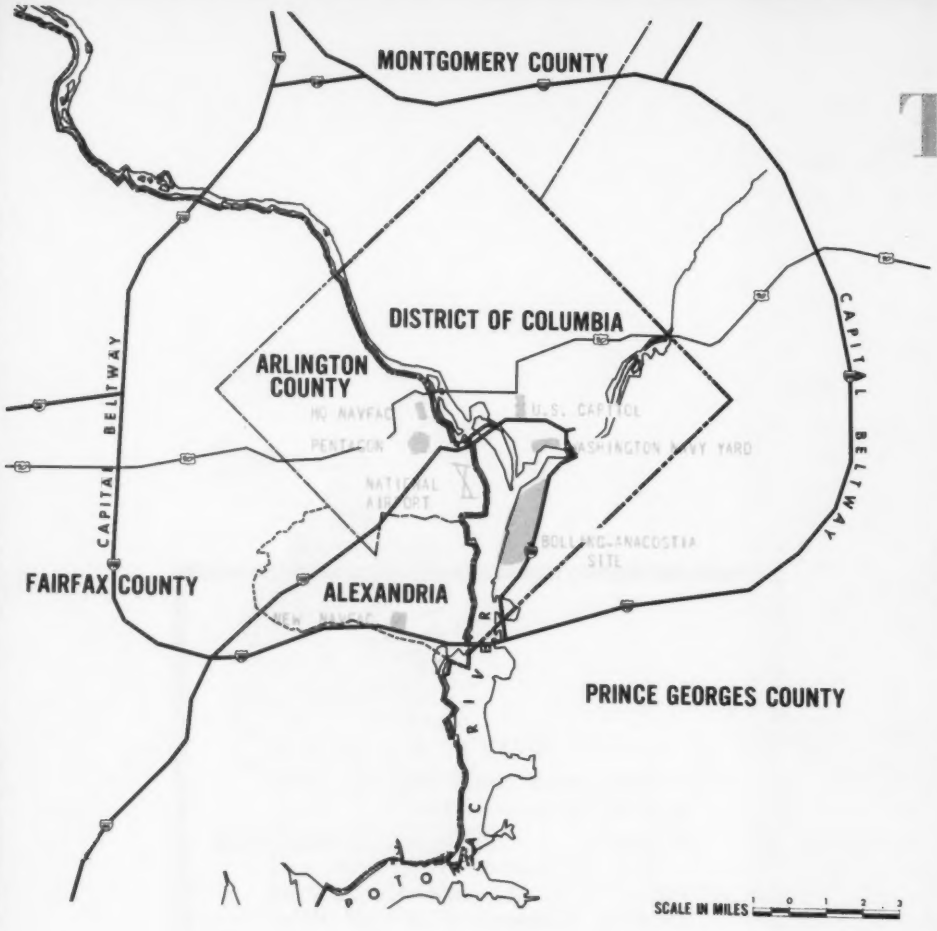
Trend to Consolidation

Bolling/Anacostia has its share of problems, but they seem to be overshadowed by the opportunities of the site. The fact that this land is downtown, and in close proximity to the Washington Navy Yard (a future administration center in itself) and the Pentagon, is reason enough that Bolling/Anacostia is ripe for development. Furthering the stand, the Department of Defense is now ready to reverse the general trend by Federal agencies to relocate in the suburbs of Washington. The Navy and the Air Force, with their initial involvement with Bolling/Anacostia are actively attempting to comply with the Department of Defense wishes. These two agencies are trying to build a large number of housing units to provide close proximity to jobs, thus easing the nuisance of commuting and traffic.

Significant in the overall plan, which was developed under supervision of the Chesapeake Division, Naval Facilities Engineering Command, is consideration



Industrial/Technical Area



Bolling-Anacostia locale in reference to other facilities within the District of Columbia emphasizes its desirability as a site for concentrating Department of Defense activities.

The Bolling-Anacostia MASTER

By LTJG W. H. SPELL, CEC, USN

• Washington, D. C.

One mile due south of the United States Capitol is a parcel of urban real estate unique to any other large tract of land in Washington. The site is commonly referred to as the Bolling/Anacostia tract, and is comprised of Bolling Air Force Base and the one time Anacostia Naval Air Station. Situated in the southeast portion of the District of Columbia, this tract of some 1,000 acres is, for the most part, undeveloped. Because of this and the economically depressed area that adjoins it, the Department of Defense and the District government have each been interested in initiating development of various types for years. The Bolling/Anacostia Tract was first used by the military in 1863 when its owner, George Washington Young, leased the property to the U.S. Army for a cavalry depot. In 1917 and 1918, the tract became an official landing field for the air service of the Army Signal Corps, and the Naval Air Station/Anacostia was also established.

President Dwight D. Eisenhower in 1958 requested the Department of Defense to report on future use and military requirements of Bolling/Anacostia, and the following year, the airfields were closed and reductions of military holdings in the area were proposed.

The Air Force requested to retain only 170 acres, and the Navy, 180 acres, thus leaving the National Capital Planning Commission to assume responsibility for urban renewal of 580 acres.

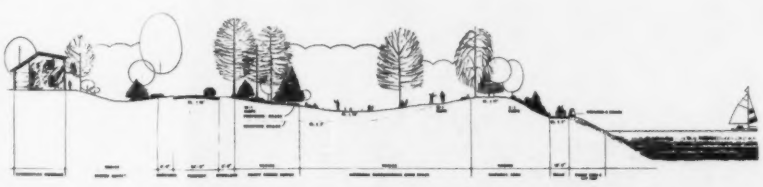
Two years later, however, the Senate Armed Services Committee suggested joint military use of the tract, and in the following year, in 1962, the Air Force produced a joint use plan for 620 acres.

From Nowhere to Limbo

Since that time, several master plans have been completed, but controversy over who should control development of the site has always produced some sort of stumbling block. In 1972, however, progress was realized when the National Capital Planning Commission approved the Department of Defense National Capital Regional Plan, (see Summer Edition 1972) opting to defer final approval of that portion recommending retention of Bolling/Anacostia until they could review a comprehensive master plan for the tract, and until an executive decision had been aired as to the tracts' final disposition. So, for the past fourteen years, the tract has existed in a limbo awaiting a firm decision.

Multitudes of problems have plagued Bolling/Anacostia, some inherent to the site and others forced upon it. Physical isolation is probably the most prominent problem and the most obvious. Even though the area is tied into a major arterial highway system, which gives the advantages of easy accessibility, it has tended to be cut off from its immediate neighbors in the city.

The Potomac River completes the isolation on the other extremity stretch-



Section drawing of a typical park

g-Anacostia
ER PLAN

Three-wing defense office building (center) is intended as the focus of numerous administrative centers for which the complex is designed.

ing over three miles along the western edge of the tract. This aspect on the river side is a very desirable feature, however, to be looked upon as an asset rather than a liability. Where in any major city can one find such an extensive amount of riverfront in an undeveloped state? The riverfront atmosphere will provide numerous complements to any development on the site.

Because a large part of the land is composed of varying types of fill, construction techniques are difficult. The topography of the site further reinforces the isolated characteristic as there is a considerable grade differential running longitudinally along the eastern boundary.

Directly across the river is National Airport, one of the busiest in the country.

Finally, the section of the city in which the site is located happens to be less prosperous and is burdened with social ills.

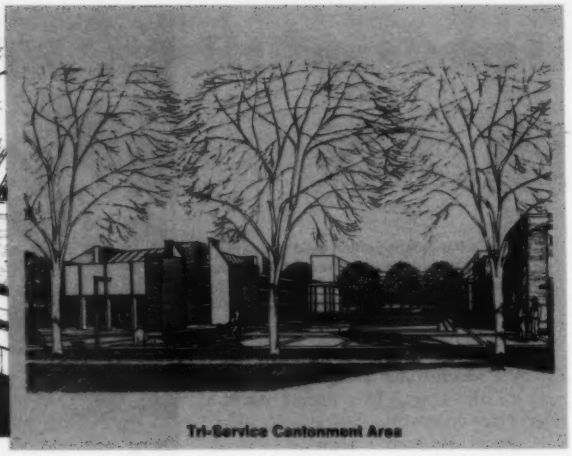
Trend to Consolidation

Bolling/Anacostia has its share of problems, but they seem to be overshadowed by the opportunities of the site. The fact that this land is downtown, and in close proximity to the Washington Navy Yard (a future administration center in itself) and the Pentagon, is reason enough that Bolling/Anacostia is ripe for development. Furthering the stand, the Department of Defense is now ready to reverse the general trend by Federal agencies to relocate in the suburbs of Washington. The Navy and the Air Force, with their initial involvement with Bolling/Anacostia are actively attempting to comply with the Department of Defense wishes. These two agencies are trying to build a large number of housing units to provide close proximity to jobs, thus easing the nuisance of commuting and traffic.

Significant in the overall plan, which was developed under supervision of the Chesapeake Division, Naval Facilities Engineering Command, is consideration

Industrial/Technical Area

Overpass and Shopping Area



Tri-Service Cantonment Area

of socio-economic and environmental factors aimed to benefit the military establishment and civilian community as well.

The administrative centers, nucleus of which is to be the three-structure Defense Office Building (DOB) complex, are designed to centralize existing operations scattered throughout the D.C. area. The DOB is to take on a role similar to that of the Pentagon, and house some 10,000 employees. The consolidation move would serve to ease fragmented operations in other parts of the city by reducing leased space and temporary buildings. The entire development will provide additional jobs on all levels for citizens in surrounding civilian neighborhoods.

Housing at the site will provide homes for some 2,000 military families, most of whom will be enlisted and junior officers, thus partially allaying the 10,000 housing unit deficit of the military services within the National Capital Region. Onsite housing, in addition, helps to reduce the commuter volume significantly.

For those additional employees who will not reside at Bolling/Anacostia, provisions have been made for upgrading the access routes. Not only has access been facilitated through improved entrances off Interstate 295, but routing of the METRO line in Southeastern Washington is currently being re-evaluated with an eye toward better serving the population in the Anacostia area.

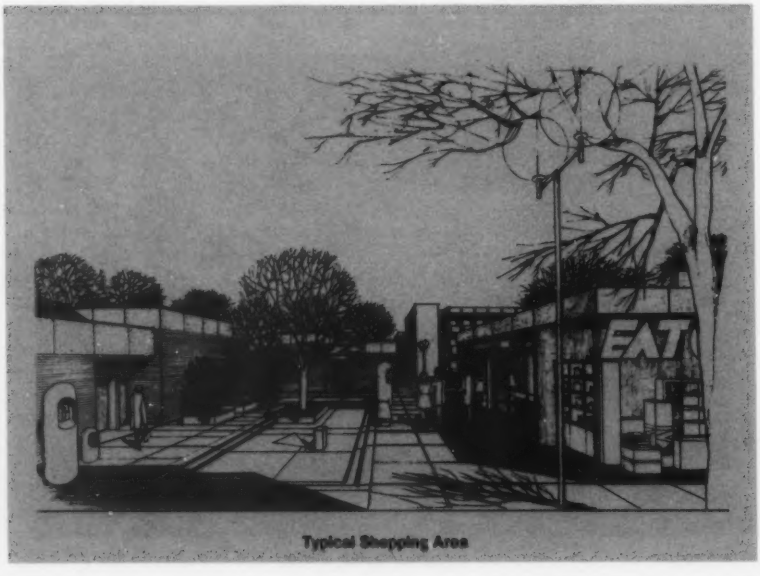
A four-lane "spine" road is planned to traverse the tract itself longitudinally, with minor roads projecting from this main thoroughfare. Parking, usually an unsightly necessity, will for the most part, be concealed by or within structures, or be carefully landscaped.

Incorporated into the plan will be a separate bicycle and pedestrian movement system designed to prevent conflict with motor vehicular traffic. These paths have been designed to provide access among the various housing areas, schools, community centers and a riverside park. The park, planned to run the full length of the tract, is a proposed ecological advance aimed at recreating a natural shoreline.

Located at strategic points within the tract, sites for elementary schools, and a high school have been planned. Shopping facilities, banks, barber shops, dry cleaners and day care centers are provided, as well as a chapel, recreation facilities, and movie theaters. In effect, the plan includes all aspects necessary for creating the very essence of the urban microcosm — a planned military community which blends with and complements its downtown setting.

Having been involved in the development of the DOD National Capital Regional Facilities Plan, CHESDIV was tasked to produce the detailed Boling/Anacostia Master Plan. Contracted to aid in the plan development were Keyes, Lethbridge and Condon, Architects. Robert Ramer was the project manager for CHESDIV, NAVFAC, and W. E. Fischer was project manager for Headquarters Command USAF.

Close contact with the Headquarters Command, USAF was maintained throughout the entire planning process and the completed plan is currently pending approval by the National Capital Planning Commission.



Typical Shopping Area

VIBRA-LO
...Locomotion is on the Skids

Artist's concept of a possible future application of Vibra-Lo as a site-clearing bulldozer. (Left) The largest experimental model of the land locomotion vibratory mechanism is inspected by Dr. Howard A. Gaberson, right, research mechanical engineer who conceived the idea, and Robert Chapler, lead engineer on the project.

• Port Hueneme, Calif.

A revolutionary but amazingly simple new concept of pulling, pushing or carrying — one that could possibly replace the bulldozer in many instances — has been developed by a research mechanical engineer at the Naval Civil Engineering Laboratory (NCEL).

Called vibratory locomotion (VIBRA-LO), the basic principle utilizes a simple oscillating weight diagonal stroke) which moves back and forth along a straight line, inclined to the horizontal. A force is created, pulling skids which support a vehicle and its payload.

This newest mode of land locomotion was conceived by Dr. Howard A. Gaberson of the mechanical systems division at the research and development facility.

The operating principles which cause the skid (or skids) to shuffle incrementally along the ground while pulling cargo, pushing away obstacles, or carrying a payload are described as follows:

At the top of the oscillating stroke, the mass (weight) is pulling the skid up and forward. Friction is reduced because of the upward force and the skid slides forward. At the bottom of the storke, the mass is pushing on the skid downward and backward. This pressure increases frictional force and backward slide is inhibited. The net effect of each oscillation (stroke) is a forward advance of the skid.

Since the skid will advance in the direction of the upward stroke of the mass, reverse motion is accomplished by simply tilting the mass and oscillator drive toward the rear of the skid. Sideways locomotion is possible by merely rotating the direction of the up-stroke to either side of the skid.

Dr. Gaberson, who has applied for a patent on his invention, has a simple description of his device: "It is a board set on the ground and shaken by a weight to go forward."

Although others had investigated applications of vibratory locomotion, NCEL is the first to actually build prototype hardware for use with heavy construction equipment. Three experimental models have been constructed in the past 3½ years. The first was run by an electric hand drill, could accommodate one person, and pull approximately 100 pounds. It had a small oscillating mass (about 25 pounds of weight stroking back and forth).

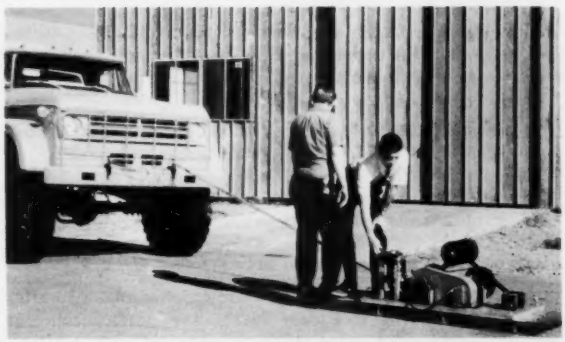
The second model was four times larger with a 100-pound oscillating mass and a pulling capacity to tow a cargo-loaded truck.

"After our second device we advanced our technology to the point where we built a test vehicle with an isolated platform to determine engineering characteristics that cannot be calculated," Gaberson explained.

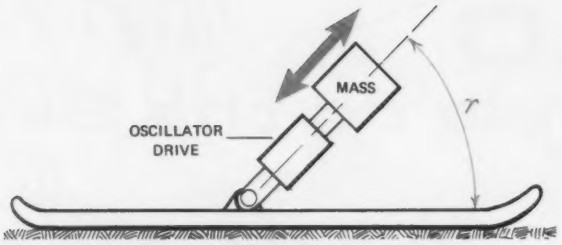
Two different oscillating weight systems are being tested independently. One is a top-driven resonant spring which drives the 12 feet by 5 feet skid while pulling 1½ tons. The second oscillator is a counter-rotating eccentric weight system with concentric shafts and phase changer. It was designed by Philip Stone, mechanical engineer at NCEL.

"This type of oscillator has the most convenient and most economical phase changer (shake angle) yet developed," Stone said. "It has no limit in terms of weight, size and power productivity." Stone is Gaberson's chief assistant on the project.

Another innovative feature of the latest version are four



An early experimental Vibra-Lo model displayed its power by towing a two-ton truck.



Vibra-Lo operates through a weight oscillating diagonally along a straight line. On the peak of the upward cycle of oscillation, the skids are lifted up and forward reducing friction and causing the skids to "shuffle" ahead.

large springs (18 inches long and 12 inches in diameter) which cushion the human, or cargo, payload from the vibratory locomotion source.

Another lead engineer on the project is Robert Chapler, mechanical engineer in charge of hardware assembly and product evaluation. "We are mating conventional components with custom-designed ones," he explained. "The only off-the-shelf component is the hydraulic power system. Other basic units, such as oscillators, springs and platforms are NCEL concepts and designs."

Gaberson points out that his concept requires far fewer moving parts than other competing locomotion devices, thus increasing reliability and reducing maintenance costs. This spells out a more economical land locomotion unit.

Furthermore, theoretical studies reveal a potential for substantially increased pulling power over conventional vehicles of similar weight.

The laboratory's VIBRA-LO will operate on all terrains on which bulldozers maneuver and will pull the same tonnage, although it is one-half the size of the tracked vehicle. And economy usually goes by weight, Gaberson said. "Although most bulldozers move faster, our device will outperform any locomotive methods in jobs calling for sheer weight pull" he predicted. "The new land locomotion invention certainly won't replace the bulldozer but it will do things the dozer can't. VIBRA-LO will push and pull with twice the force of tracked vehicles while using less engine power."

Gaberson's third experimental model has a 12 hp gasoline engine, a drive train, oscillating mass, and the skid. Total weight is 2½ tons. Next year, plans call for fabrication of a fourth device with a 48 hp engine. With a total weight of 14 tons it will be larger than the D4 class of bulldozers.

Comparing the smaller VIBRA-LO unit with massive bulldozers, the research engineer singled out the D9 classification with its 385 hp engines, 45 tons in weight and two tracks with seven rollers per track.

"We propose to equal the bulldozer, and on some jobs outperform it, with a vibratory locomotion system that will be one-half the weight and one-third the power," Gaberson said.

Since the extreme simplicity of the concept minimizes "down time" for repairs and maintenance, operators won't have to worry about complications surrounding the complex track system on bulldozers. Thousands of man hours are spent each year in research, improving the serviceability and dependability of tracks, Gaberson said. But bulldozer manufacturers are dealing with a system which includes transmissions, gear shifts, bearings and differentials.

How did the NCEL engineer get the idea for such a simple vibratory locomotion device?

"I learned the hard way," Gaberson replied. "About six years ago I was doing research on vibrating conveyors that jiggled dirt on a moving trough. It dawned on me to turn the conveyor upside down for direct contact with the ground. That didn't work. But then the possibility of utilizing an oscillating mass alone occurred."

A research engineer who obviously enjoys his work and tells visiting VIP's that he "has more fun that anybody at NCEL", an enthusiastic Gaberson envisions a variety of Navy-applications for the VIBRA-LO concept such as: stand-by land locomotion capability for landing craft and other boats; a heavy concrete ram vehicle to clear roads of obstructions; general marginal terrain hauling vehicles; maneuverable marginal terrain forklift for over-the-beach hauling and advanced base warehousing; and mobilizing of large gantry cranes in shipyards.

With the cooperation and skills of fellow engineers and technicians, Dr. Gaberson is developing a new dimension to man's modes of land locomotion which presently include the wheel, tracks, air-cushion vehicles and walking.

A CLEANER PENSACOLA BAY

•Pensacola, Fla.

The navy is returning water to Pensacola Bay almost 100 percent pure following completion of a new waste treatment facility at the Naval Air Station here. The plant, under construction since 1968 and put into service early this year, is the first navy facility designed specifically for industrial use, according to PWC spokesmen.

The system, costing slightly more than $2 million, is operated by the public works center. The most advanced in the area, it purifies industrial and domestic waste by bacterial action.

Industrial wastes, consisting of cyanides, phenols, oils and greases, and solids were formerly discharged directly into Pensacola Bay; domestic waste was subjected to only primary treatment before being discharged into the bay.

To eliminate the pollution problem, the navy determined to build facilities for industrial waste treatment and to add secondary and tertiary treatment.

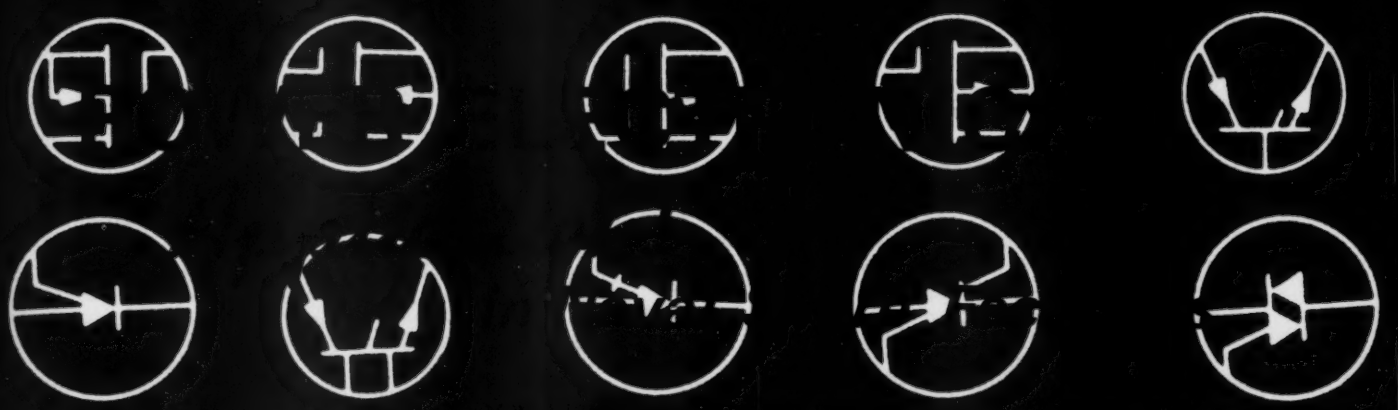
Topographic conditions at mainside required that all wastes be pumped to the treatment plant. The gravity collector sewers are designed for peak flow conditions and at grades required to maintain a minimum velocity of two feet per second when flowing full. Vitrified clay pipe is used for gravity lines and cast iron pipe for force mains because of the corrosive content of the waste.

Sediment traps have been installed to remove paint material at three shops where aircraft are cleaned prior to overhaul. Paint stripping chemicals are hauled to the existing solid waste disposal area. The actual treatment for both industrial and domestic waste involves mechanical, chemical and biological procedures. Due to the natures of both types of waste, it was essential that separate collection systems be provided. After initial treatment of solids, toxic metals, oils and greases, the two systems are integrated to augment each other in the secondary and tertiary treatment stages.

Traps for collecting rainfall runoff in open areas have open grates with discharge directly into the collection system.

Water analysis of samples taken January 5, 1972 showed the plants to be operating satisfactorily, with discharge meeting or surpassing standards imposed by Florida's Department of Air and Water Pollution Control regulations.

The navy is not stopping there, however. A PWC spokesman said a third treatment facility is being considered to provide for the land disposal of effluent wastes so that water returned to Pensacola Bay will be 100 percent pure.



• Washington, D. C.

The state of the art in semiconductor electronics applications in power engineering, importantly forecasts the effect of some developments on the shore facilities of the navy, particularly in the area of public works management.

The hybrid field of power electronics, although now ten years old and growing fast, is not yet readily embraced by either power engineers or electronics engineers. Within the Navy, this fact is evident in the uncertain lines of technical responsibility drawn between the facilities and electronics support elements of the Naval Material Command.

Nevertheless, the public works officer of the coming decade will find a number of applications of power electronics at his shore activity, and he must become familiar with the semiconductor devices which are used.

The semiconductor has had a great impact on power control and conversion technology. A wide range of device ratings are now used in a number of applications by a variety of manufacturers. The patriarch of the line, the thyristor, is rapidly replacing older methods of power conversion. Voltage and current handling characteristics of thyristor devices are being refined and increased continuously, leading to their application in more and more areas. Complete technical descriptions and circuit details are beyond the scope of this article; readers may refer to any of the handbooks on the subject.

Other power semiconductor devices under development in addition to diodes and thyristors are the triac, light-controlled silicon switches, and reverse-conducting thyristors. All of these are considered under the generic term of semiconductor power conversion devices.

SCR For Power Control

The best-known member of the thyristor family is the SCR (silicon controlled rectifier). The SCR combines functions of the silicon rectifier diode and the transistor. It is equivalent to a rectifier in that it conducts current in only one direction, but it has the added capability of controlling the start of conduction at any predetermined time. Conduction can also be stopped, either by a signal to the SCR or by allowing the current to fall below a predetermined value.

The device, then, is basically a very-high-speed electronic switch. Its ability to be very quickly turned on and off with little energy has led to its application in many control schemes. The first applications of the SCR in industry were in simple lamp dimmer devices, heat controls, and motor phase controls. These early applications have largely been assumed by triacs, and SCR's have gone on to become key components in large static power conversion equipment.

The two most widely used industrial SCR applications do not have significant impact on the naval shore establishment: rectifiers for electrolysis and metals processing, and control and drive systems for railway and rapid-transit use. On the other hand, semiconductor devices will be increasingly applied to power control and conversion on a scale suitable for widespread use by Navy facilities engineers. The public works officer must learn how to apply, operate, and maintain these devices.

One of the most important applications of semiconductor devices in naval shore facilities at present is in "no-break" or uninterruptible power supplies. The installation of more sophisticated real-time-dependent computer systems and synchronized communications equipment makes it all the more essential to supply these loads without interruption of power.

Solid-state semiconductor systems are now offered by a number of manufacturers. The semiconductor circuits utilize SCR devices to rectify incoming AC power. The resultant DC power provides charging current to a battery bank, and also provides input power to an SCR inverter, which converts the DC back into high-quality AC power for the critical load. If the incoming AC power should fail, the inverters continue to operate from the battery, and no interruption is felt at the load.

Transient Protection

These power supplies are replacing older schemes which utilize motor-generator sets and flywheels with automatic-start diesel generators, and are now installed at communications, security group, and computer activities. Their use will increase, not only to replace older rotating sets, but also to satisfy requirements for new equipment.

Developments in semiconductor transient suppression devices indicate their applicability at naval activities to protect sensitive equipment from damage due to power line transients. These devices, then, may be applied to loads needing only transient protection, with the uninterruptible power supply used only for those loads needing protection from momentary outages or frequency variations.

A similar application of semiconductor devices which will become more common at naval activities is in frequency conversion. Many foreign countries do not use the standard U. S. frequency of 60Hz for AC power. Navy shore activities in these areas must convert the local power in order to utilize U. S. equipment. Further, special applications at other activities of 400 Hz and 1,000Hz electric power also require the conversion of normal supply frequencies.

In the past, the frequency conversion and any required voltage transformation was done by rotating motor-generator sets. These sets are being replaced by semiconductor rectifier-inverter converters. The equipment is essentially the same as

(continued)

that used for uninterruptible power supplies, but without the standby battery supply. The converter changes incoming AC power to DC and then back to AC with the desired frequency and voltage.

The development of semiconductor power devices has led to new design concepts of rotating machinery. Radio-frequency noise generated by sliding contacts in electrical machinery, such as brushes, commutators, and slip rings, must be controlled to avoid interference with communications equipment. This previously has been done by using filters and capacitors and by shielding and bonding methods. For several years, designs have been developed to eliminate the noise at its source rather than control it after it has been produced.

SCR circuits are now used in AC generators to provide a brushless design which accomplishes this. With the elimination of brushes, slip rings, and commutators, the generator is free of interference-producing sources. These generators will be used at naval installations where the environment must be kept free of radio interference. The elimination of these mechanical contacts also eliminates wear and maintenance problems, which is a great advantage in motors as well. Several models of brushless SCR motors are marketed today.

Applications for AC Motors

Adjustable-speed motor drives are required in applications such as machine tools, pumps, fans, cranes, and elevators. DC motors have traditionally been favored for this use. Speed was controlled by adjusting field or armature current or voltage through adjustable resistors or by using fluid couplings or motor-generator sets. These methods are expensive, bulky, and inefficient.

The first electronic motor drives used tube thyristors and ignitrons to control armature voltage. As the semiconductor thyristor was developed, it was applied to many DC motor drives. The thyristor rectifier, controlling a separate-field DC motor, is in fact the largest single use of power semiconductors today.

Current research is directed toward applying SCR control to AC motors, since AC motors are cheaper than DC motors and have certain more desirable characteristics. Recent applications provide a rectifier-inverter system which first converts the AC line power into DC, then back into controlled adjustable-frequency AC power for the motor. The cost of the system is high, but the cheaper AC motor makes the overall drive cost competitive with a DC system.

The AC drives are particularly applicable to hazardous-atmosphere use, as in explosives-handling facilities. Phase control is another means of controlling AC motors, by connecting the motor to its power source for only fractions of each cycle. The fast switching that can be done by SCR's accomplishes this, and applications can be found in furnace blower controls and in heating and air-conditioning systems.

Solid-state motor drives are in use today to control the speed of motors from fractional-horsepower hand tools to 10,000 horsepower pumps and hoists. Large adjustable-speed motor drives utilizing these SCR devices will be used in naval industrial plants, shipyards, and rework facilities.

The use of cordless hand tools will increase. Popular battery-powered tools now on the market, such as grass clippers and carving knives, use semiconductor rectifiers in their battery-charging circuits. Larger tools, such as drills, will also use SCR speed controls. These cordless tool applications will assist public works crews in field work where there is no convenient power source.

Power control systems are basically all solid-state in battery vehicles and transit systems. Current environmental protection concerns will hasten the development of electric automobiles. The Department of Transportation is investigating personal electric car concepts, and several prototypes have been developed.

The electric vehicle is particularly applicable to short-haul use where ample time is available to recharge batteries, and well may become the vehicle of tomorrow's navy transportation pools. Materials-handling equipment will be generally controlled by semiconductor motor drives, and will utilize SCR circuits to recharge batteries during idle hours. Electric vehicles, with many moving engine parts replaced by semiconductor controls and battery drives, will greatly reduce maintenance expense. A typical drive system would employ a battery for DC power source, a semiconductor chopper regulator and a drive motor. The chopper utilizes SCR devices to control the motor voltage. More sophisticated designs will employ a vehicle-mounted battery charger, again using an SCR rectifier circuit. Looking further into the future, air-cushion vehicles and magnetic suspension systems will require even more semiconductor control circuits.

Power semiconductor devices are replacing conventional mechanical switches in a number of applications. Aside from the obvious advantage of having no moving parts or contacts to wear, the semiconductors can operate far faster than the older switches. Applications at naval facilities will be in starting large motors at reduced voltages, for tap changing in transformers, for protective relay switching on distribution systems, for fast transfer of important loads from normal to emergency power sources, and for fast startup of emergency equipment.

Communications and Alarm Systems

Laboratory evaluation of fast transfer switching was begun by the Naval Civil Engineering Laboratory several years ago, and several models of reduced-voltage motor starters are marketed today. Investigation into fast asynchronous switching indicates the possibility of eliminating power bus synchronizing equipment.

Where motors must be started and stopped frequently, or where the starting switch could produce undesireable contact arcing, SCR devices will replace the mechanical contactors. This will be particularly useful where explosive fumes or dust are present.

In addition to these applications in the power field, public works officers are finding greater uses of semiconductor devices in more conventional areas in their field of responsibility. Telephone, intercom, and public-address systems, as well as fire and security alarm systems, are becoming more solid-state. In transportation, several manufacturers have already announced semiconductor ignition, fuel injection, and voltage regulation devices.

Solid-state timing, sensing, and switching devices are being developed for applications in household appliances and comfort systems. Thyristors are replacing mechanical servos for control feedback applications, as in the positioning of automatic welding rigs and antenna rotators. Water heaters, ovens, and other heat processing systems are temperature-controlled by semiconductors.

This brief summary has indicated some of the current applications of electronics in areas of interest to facilities managers. The power electronics industry is growing rapidly, and many familiar devices for power conversion and control will be replaced by new semiconductor devices. The Civil Engineer Corps officer in public works management must be prepared for the electronics age in his future.

ENGINEER REGISTRATION

Its Background and Its Importance to the Engineer

By LCDR JAMES C. DOEBLER, CEC, USN

• Norfolk, Va.

The concept of legal registration and licensing of persons qualified to practice engineering before the public has been in existence in this country for over a half century, but statistics show that only about one-third of the engineers now employed in the United States and its territories possess professional engineer's licenses!

This seems to indicate that something is wrong, either with the concept itself, or with the individual engineer's perception of that concept, as influenced by the public, by various engineering societies, by industry, or by other engineers.

Legal registration had its beginning in 1907 with the passage of a law by the State of Wyoming requiring certification of an engineer's qualifications by a board of examiners and issuance of a license before the engineer could practice before the public in that state. Other states have since followed suit. The primary purpose of these laws is to protect the public from unscrupulous and incompetent practicioners in matters affecting the public welfare and/or endangering life, safety, health, or property.

A secondary purpose inherent in the state registration laws is protection of the profession. This is important not for the anticipated personal gain of the engineer, but because the public confidence in the capability of the engineering profession as a whole will be influenced by the unsatisfactory performance of the incompetents and the unethical conduct of the unworthy.

It is well to note, however, the cautioning words of J. D. Kemper:

> ". . . . *a fine line exists between legislation that protects the public and legislation that protects the profession. It is a nice exercise in semantics to distinguish between 1) moves that enhance public esteem for the engineering profession in order to increase the confidence in which the public may seek the service of engineers, and 2) moves that enhance the financial position and personal prestige of engineers. The former motive has a proper place in public policy; the latter does not.*"

The legal basis for engineering registration has its root in the police powers of each individual state, under which the state can impose restraining actions on its citizens in the best interests of the public welfare. Licensing of professionals permits the state to exercise this restraining action by establishing minimum qualification standards and determining that an individual meets these standards before licensing him to practice his particular profession.

Perhaps the first positive influence on the growth of engineering registration was the adoption in 1911 of a model law as a guide for state legislative bodies to use in patterning their own individual registration laws.

This model law is husbanded by the National Council of Engineering Examiners (formerly the National Council of State Boards of Engineering Examiners) and has materially assisted in bringing about a degree of uniformity in the individual state registration laws which now number fifty-four, encompassing all fifty states plus the District of Columbia, Guam, the Virgin Islands and the Panama Canal Zone.

The number of registered engineers has risen from about 10,000 in 1930 to approximately 300,000 under the jurisdiction of the fifty-four regulating agencies. Licensure in one state, however, does not permit practice in another state. This in itself could have dealt a serious blow to the advancement and growth of individual registration, if it were not for the practice of "comity" between the various state boards. A working arm of the NCEE known as the National Bureau of Engineering Registration (NBER) has the primary function of minimizing the difficulty and expense of multiple state registration.

The NBER maintains records on all registered engineers, and furnishes appropriate information upon request to state boards in the form of a certificate of qualification. Most states recognize these certificates as valid evidence that the engineer has obtained his license through the bona fide process of education, experience and examination, and the issuance of a reciprocal license is facilitated.

A second positive influencing factor has been the activity of the National Society of Professional Engineers (NSPE), whose membership consists of professional engineers and engineers-in-training. The NSPE has dedicated its effort to advancement of the engineering profession under the first of Kemper's motives cited earlier (increasing the public confidence).

Excerpts from the NSPE Code of Ethics clearly indicate the society's position regarding the practice of engineering:

> *Section 6* — "The engineer will undertake engineering assignments for which he will be responsible only when qualified by training or experience; and he will engage, or advise engaging, experts and specialists whenever the clients' or employer's interests are best served by such engagement."
>
> *Section 13a* — "He will conform with registration laws in his practice of engineering."
>
> *Section 15c* — "He will urge his engineering employees to become registered at the earliest possible date."

Court Status

Another powerful motivating factor in the growth of engineering registration is the legacy of legal decisions resulting from numerous court cases. Under the state registration laws it is illegal for an unlicensed engineer to practice engineering for a fee. Courts have refused to support a claimant's request for payment for performance of engineering services when it was shown that he was not a registered engineer.

Also, engineers occasionally desire to testify in court cases as expert witnesses. The value of such testimony is dependent on the expert qualifications of the witness. Possession of a professional engineer's license helps to establish the competency of the engineer in the eyes of the jury. Another aspect of the legal motivation for engineering registration is the degree of protection it provides the individual professional engineer. One modern textbook on law in engineering summarizes this point as follows:

> "Professional engineers and architects are obligated legally to use with reasonable diligence their best knowledge and experience in rendering service to an employer or client, but the law does not require perfection, or absolute accuracy or complete

success in the execution of their work. They are liable for negligence, not for an error in judgement."

This is not to imply that the professional engineer is exonerated in advance for careless mistakes, which will be buried under the heading of judgement errors. The same reference continues with a discussion of reasonable diligence:

"Failure to exercise reasonable diligence in the application of his ability and knowledge, provided it is of the type ordinarily exercised and possessed by others in the same profession, may subject any professional man to a charge of malpractice."

The legal results of unprofessional practice are devastating, since ". . . the professional engineer can be held legally responsible, and his registration revoked, if there is evidence of gross negligence, incompetence (eg., practicing in a field outside of one's area of experience) or misconduct." This legal background has given many engineers the incentive to become registered and to practice the highest level of professional ethics.

Lack of Compulsion or Incentive

Turning now to the factors which have been a barrier to greater growth of engineering registration, the most obvious is the exemption of certain engineers from the requirements of registration. Most state registration laws require registration only for those engineers who will represent themselves directly to the public.

This "direct" category *excludes* officers and employees of the federal government, elected officials of state and local governments, employees of registered engineers, and employees of manufacturing concerns where the firm assumes full liability for the manufactured product.

Clearly, where registration is not a mandatory prerequisite of employment, much of the incentive to become registered is removed at once.

Fragmentation of the engineering profession into its many constituent specialized groups has also been a deterrent to greater acceptance of engineering registration. Active support by many of the technical societies in the past has been weak to say the least.

For instance, the American Institute of Chemical Engineers (AIChE) says that registration ". . . should be accorded no greater importance than is placed on the other indications of professional status, such as academic degrees, membership in professional organizations, technical publications, and advancement in industrial, academic and governmental careers."

The public's perception of engineering as a profession has been less than heartening to the proponents of increased engineering registration. The mere possession of a state license does not automatically elevate one into a profession in the eyes of the public. There are licensed barbers, beauty operators, taxi drivers, and automobile operators, but certainly none of these is considered as constituting a profession.

There is a much higher image which engineers must create if they desire public acceptance as members of a profession such as medicine, law and dentistry.

Engineers Unaware of People

A. W. Weber, who is vice-chairman of the New York State Board of Engineering Examiners, cites four major roadblocks to realization of increased registration on a broad scale, with resultant unification of engineers as a professional group:

- Refusal of state boards to modify existing licensing practices where necessary
- Irrelevance of licensing exams to the modern engineering situation
- Self-righteousness of some licensed professional engineers
- Lack of emotional and intellectual appeal in present NSPE programs

Finally, Dr. Melvin Nord, P.E., writing in the *Michigan Professional Engineer*, suggests that the cause of the slowness of engineering registration growth is the engineer himself:

"In the last analysis, however, the principle factor in the lateness of the development of engineering registration has been not so much that people are unaware of engineers, as that engineers are unaware of people, including themselves.

That is to say, the typical engineer thinks of engineering, but does not think of engineers. Since no one else does either, we can see why engineering registration has lagged, until recently at least."

The future of engineering registration and its importance to the individual engineer can best be visualized by considering the support being given by various elements throughout the country. The NSPE of course is perhaps the heartiest acclaimant. Aspirants to consulting engineer positions have no alternative to registration — it is a legal prerequisite to practice. Founder and other technical societies are elaborating their own positions, and while not being as vocal as the NSPE, most recognize the practical value of holding a license. Note even the AIChE position statement:

". . . any engineer in the course of his career may wish to become engaged in activities requiring registration. Therefore, the AIChE recommends that its members should, as a practical expedient, become registered in their respective states as soon as possible after entering the profession."

Certain segments of industry have been staunch supporters of increased registration. Phillips Petroleum, since 1956, has given employees time off with pay to take registration examinations, and has paid all costs incidental to obtaining initial registrations, seals, and renewals. According to a Phillips' engineering executive, "the company sets the example for its engineers to think and perform professionally." At General Electric, ". . . engineers are informed that registration is one of the several important measures of their professional standing. Departments encourage engineers to display their registration certificates, which are framed at company expense."

Registration Incentives

Still another example of industrial support:

"The duPont Engineering Department has made it clear that it considers registration as a professional engineer to be a significant personal accomplishment which merits recognition as achievement of professional status. Registration, like all other aspects of professional development, is supported through education, encouragement and persuasion. The Department believes that true professional development is necessarily a function of the individual and that management efforts to 'legislate' professional development would be self-defeating."

Engineering elements of the Armed Forces actively support registration of their officer corps. The U.S. Army Engineer School at Fort Belvoir, Virginia sponsors refresher training for the professional engineering examinations as a correspondence course which is available to all military officers. The U. S. Navy Civil Engineer Corps (CEC) openly encourages registration for all its officers, and it is a well known and publicized fact throughout the CEC that possession of an EIT Certificate for young officers and a PE license for more senior officers is an indication of

individual initiative, and that this is reflected in officer promotions and duty assignments.

Registration is encouraged for government engineers in the Federal Civil Service. Although these engineers are exempted by law from the requirement for registration, many government engineering position descriptions require the incumbent to be a licensed professional engineer. This is also an item taken into consideration by supervisors in reviewing candidates for a vacant position. Registration can often be the factor which tips the scales in favor of the P.E. as opposed to the non-registered engineer.

Changes Needed

A new twist to the future of engineering registration may have been given by the NCSBEE (now NCEE) in 1964 when it adopted a resolution stating that in the future the minimum educational level for entry into the engineering profession should be the Master's Degree obtained in at least one academic year beyond the normal baccalaureate engineering program. This is in keeping with the concept that a profession is an occupation which requires specialized knowledge and technical competence obtained by advanced education.

While it will undoubtedly be years before such a resolution is translated into law by individual states, it will eventually have the effect of excluding baccalaureate level engineers from professional status. Those who already hold a license before the new provision takes effect presumably will be allowed to continue their practice.

A. W. Weber outlines a six-point program for improving the licensing system and consequently increasing the growth of engineering registration. In view of his influential position as a member of the New York State Board of Engineering Examiners, it is quite conceivable that these points will be adopted at least in part in the near future:

- Revise the examination procedures to be more compatible with modern engineering education.
- Staff the state boards with men anxious to accomplish broad improvements to the licensing program, not merely to administer the fine points of a law.
- Recognize the extensive educational requirements of a true profession. (Note the close tie-in with the 1964 NCEE resolution.)
- Encourage the NSPE and ECPD to join ranks for the common good of the profession.
- Solicit more active Founder Society support of licensing efforts.
- Critically review the present status, the long range objectives, and the NSPE and NCEE plans for meeting those objectives.

In spite of his rather sharp criticisms of the existing system, and the broad overhaul program he suggests for the future, Mr. Weber adds:

> "Regardless of one's agreement or disagreement with the problems discussed here, every young engineer should get his license as quickly as possible following graduation from college. He may or may not need it in his work, but at the present time this is immaterial. In the long run, the pressures to change licensing programs must inevitably come from those who *have* licenses rather than those who do not."

Advantages In Registering

Appeals to young engineers to become registered for the good of the profession will probably have little effect, since the young engineer may not yet feel a sense of obligation to the profession. This is an attitude which will grow as he advances in professional development. Strangely enough, licensing will help instill this sense of professional pride in him. The first and often most successful appeal for early registration should be based on the benefits of registration to the individual engineer himself. A partial list of these benefits is presented here in the hope that young men will identify with several of them and initiate the necessary action to become registered as early as possible.

Registration as a Professional Engineer

a. Is required by state law for any engineer who offers service directly to the public.
b. Is an indication of technical competence and is often used as a measure of potential for promotion purposes, in both the military and the civilian environment.
c. Will become more important in the future while licensing requirements will undoubtedly become stricter, so the earlier a license is obtained the better, from the individual's standpoint.
d. Provides legal recognition of professional status by a board of his peers in the engineer's chosen field.
e. May be required for a future job the engineer might be interested in.
f. Will permit the engineer to testify in court as an expert witness.
g. Will insure legal backing in the collection of just fees for engineering services rendered.
h. Is often required by companies for engineers occupying managerial positions.
i. Will instill the confidence of subordinate engineers in their manager.
j. May permit part-time or post-retirement consulting work.
k. Provides a forced period of self-development during the time taken to study and prepare for the examination.
l. Shields the P.E. from unfair competition which would willingly stoop below ethical principles in order to obtain customers.

As a preliminary step, licensure as an Engineer-In-Training (EIT) forms the groundwork for later P.E. registration, and helps link the young engineer to the affairs of the profession. This in turn will develop a sense of professional pride, so that in his dealings and discussions with the public he can represent the engineering profession in its best light. Further professional development will follow, and will result in the desire to lead others to follow him and to carry on with the advancement of the profession.

Pathway to Professionalism

The future status of the engineering profession lies in the hands of young engineers. Their advancement into the professional ranks through engineering registration will hasten the day when engineering can be considered a true profession. The challenge to the young engineer is threefold:

a. Obtain your EIT Certificate immediately after graduation, and apply for admittance to the P.E. exam at the earliest date permitted by your state board.
b. Become active in technical and professional societies, as this is one of the hallmarks of professionalism. Remember that the title "P.E." connotes not only equivalent education and experience, but equivalent dedication to the principles of professional ethics and interest in the stature of the profession.
c. Do not consider engineering registration as an end in itself. It only opens the door to the profession. It is your obligation, once a member, to support and enhance the professions's growth. To quote Thomas Huxley, "The rung of a ladder was never meant to rest upon, but only to hold a man's foot long enough to enable him to put the other somewhat higher."

QUICK CAMP

NCEL Tests Portable Camp Structure Models

• Port Hueneme, Calif.

Another concept of transporting and quickly emplacing temporary but self-sustaining Seabee camps in remote regions has been developed by the Naval Civil Engineering Laboratory.

Called the quick camp system it introduces a new philosophy of mobility, economy, containerization, and transportation toward moving and emplacing camping facilities for Mobile Construction Battalions.

In terms of cost effectiveness and manhours saved, a 25 to 50-man quick camp exceeds the capabilities of buildings and tents.

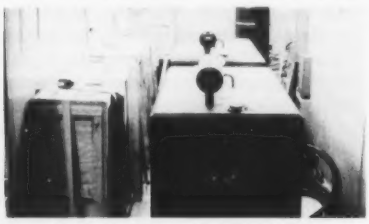
NCEL has designed and developed a prototype system which is containerized, relocatable and transportable by all standard carriers (air, ship, truck and rail). The system affords smoother logistical support, greater operational expediency and reduction in the percentage of pilfering.

A typical quick camp consists of a combination of seven modules and three special packages. Each module measures 8 x 8 x 20 feet and is rigged with proper corner fittings and straddle carrier slots for inter modal handling and transporting. Each structure is constructed of three-quarter-inch plywood with a coating of fiberglass-reinforced plastic (FRP) bonded to both sides of the panel. The interior is insulated.

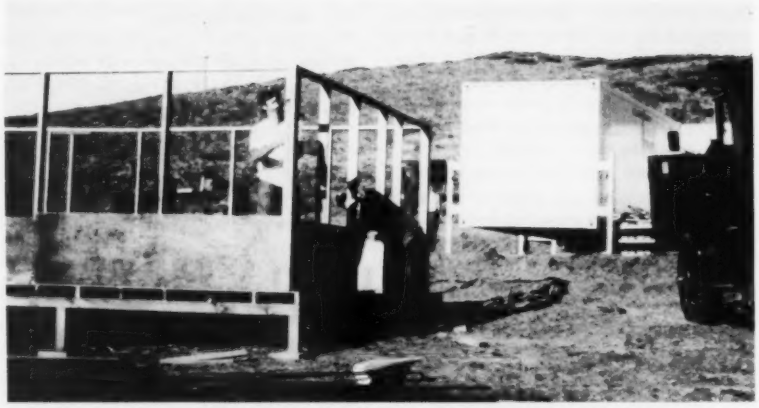
In transit the modules serve as shipping containers of general cargo and packages. When not in use, the modules become storage containers which can remain outdoors throughout the year. In this capacity alone they represent a healthy savings in warehouse storage fees. At a campsite the structures revert to their prime function, that of a specially-designed habitat module.

A breakdown of the seven-module system reveals:

• *All-purpose module* — provides shelter for messing, laundry, recreation, storage and/or general working space.



Utilities module contains two electrical generator sets, two collapsible 3,000 gallon water storage tanks and the water storage tanks and the water purification plant (dark steel drum at right rear).



Quick Camp vs. strong back demonstration in which six men emplaced three Quick Camp modules in only three hours while it took 12 men six hours to complete the strongback tent in foreground.

It also serves as a standard shipping container.

• *Administration/medical module*— provides berthing for two men, a two-man office, communications station, and a medical facility.

• *Berthing module* — provides sleeping quarters for six men. With folding bunks in an "up" position, the structure is used for transporting special packages.

• *Kitchen module* — provides food storage, refrigeration, preparation, and serving facilities for 26 men. A complete messing facility is formed by combining functions of the kitchen and all-purpose modules.

• *Work shop module* — provides working space for steelworkers, builders, electricians, utilitiesmen, equipment operators and mechanics.

• *Camp utilities module* — provides electrical power, water purification, storage, and distribution.

• *Latrine/shower module* — provides four shower stalls, four wash basins, mirrors, shelves, storage space, and three chemical toilets.

Pointing out the speed of installation, Richard H. Seabold, senior project engineer at NCEL, said a seven-module camp for 13 men can be put up in 5½ hours. It would take five days to construct a campsite with similar facilities using different building methods.

Two prototype modules recently underwent varied and severe climatic tests at the Environmental Laboratory, Naval Missile Center, Point Mugu, Calif. Seabold said temperatures were soared to 100 degrees with 80% relative humidity. Then the chamber was dropped to 38 degrees below zero and 40% relative humidity. Next came a torrential downpour with four inches of rain per hour plummeting the roofs. The same roofs then supported 18 inches of snow that fell within 24 hours.

Commenting upon the tests, Seabold said, "The basic structure proved excellent. It achieved trouble-free operation at low temperatures and was resistant to leaking. Air conditioners and heaters showed adequate capacity to perform at varying temperatures." But the senior research structural engineer candidly added that "some redesign is necessary around doors and vents to obtain water tight conditions."

The first prototype messing facility (kitchen and dining areas) has been emplaced by Seabees as a field exercise at Vandenberg AFB, approximately 100 miles north of Port Hueneme.

Packages within a *quick camp system* contain equipment, furniture and supplies. They are stored and carried

Two modules withstood severe climatic tests at the Naval Missile Center's environmental laboratory at Point Mugu, Calif., where temperatures were dropped to -38° and 18" of snow accumulated on the roofs.

All-purpose module with messing package is linked with the kitchen module, visible through door in background.

Modules are light enough to be easily handled by conventional equipment shown here.

within modules. At the campsite they are opened and the contents are installed in various facilities. For instance, the messing package contains tables and chairs which are placed inside the all-purpose module. In turn, the all-purpose module is coupled to the kitchen module to form a complete messing unit.

Seabold said the *quick camp system* is designed to achieve the greatest efficiency when used by 26 men. Maximum benefits are realized when the modules are frequently relocated after short "stay" times (one to four weeks).

The entire concept centers around the advantages derived from containerization and the use of helicopters which can fly the modules into otherwise inaccessible areas. The totally containerized system meets worldwide standardization regulations recommended by the International Standards Organization, Seabold stressed. Modules can be carried by commercial and military ship, rail, truck, and air; reaching final remote destinations by helicopter.

Quick camp modules (no foundations required since the structures are emplaced) utilize five subsystems; structural, electrical, air treatment, water distribution, and sanitation. High electrical power is required since this subsystem is used for heating, ventilation, air conditioning equipment, and a recirculating hot water facility.

Uniqueness of the quick camp concept produces a combination of qualities (relocation, containerization and intermodal transportation) not found in any other camping system now in use, Seabold said.

A structural-mechanical-transport-storage integrated system, it provides multiplicity of function not available in building and tent campsites. Buildings are unable to provide mobility and operational expediency and tents cannot provide comparable habitability, long planning, and pilfer resistance which are features of the NCEL system.

Career Development Program For PLANNERS And ESTIMATORS

By BERNARD T. LEWIS, P. E.
and
LT. JOHN J. PICCO, CEC, USNR

A career development pattern for planner and estimators (P&Es), should be established from the time of appointment, to prevent that occupation from becoming a dead-end, and devoid of promotional opportunities. Otherwise, the most promising craftsmen and potentially the best P&Es will not attempt to obtain such a position on the civil service register.

A recent study of selected field activities emphasized the urgency of public works officers to undertake action to develop the P&E career development patterns. The study revealed the major problem areas.

The planner and estimator billet is viewed by many craftsmen as an "end of line" assignment until retirement.

As a result of this attitude most planner and estimators are in their late 40's or early 50's. Civil service registers carry craftsmen even older. Normally, only 20-25% of qualified craftsmen ever apply for the register and few of these are under 40.

Planner and estimators generally feel that when they apply for a supervisory position their P&E experience works against rather than for them.

They also believe that selection boards, tend to rank shop supervisory experience as a more important selection factor than overall understanding of the maintenance management system; orientation toward labor and material cost control; and an overall sense of cost consciousness.

A career path, not usually exploited, is that of P&E to *engineering technician.* The objective is to develop the P&E's creative and active independence so his expanding set of skills can be used to improve the public works department effectiveness.

If he does not succeed in becoming a supervisory P&E, or a maintenance division supervisor, then he should have the opportunity as an engineering technician in either the engineering or maintenance control divisions.

This tactic allows him to become graded, in lieu of ungraded, and white collar, in lieu of blue collar.

New vistas are opened with the accompanying new interest for younger craftsmen in placement on the civil service register.

The maintenance control division director should provide for job enlargement and, to a degree, job rotation with shop supervisors to develop greater self reliance, productivity, and responsibility. A course of instruction could be given to those qualified on the objectives, functions, and methods of planning and estimating to stimulate interest the civil service graded position. This instruction cannot be mandatory, but it is one that can be emphasized by the public works o-ficer as the first step up a P&E ladder.

A most important facet of P&E career development is acceptance by the public works officer of the need for such career development. If experience and knowledge of planning and estimating is given proper weight by the PWO for promotion, then it will permeate the department and will be accepted more readily and used more effectively.

A career development pattern for P&E's is necessary to increase effectiveness of the public works department through use of the maintenace management system. Immediate emphasis should be given to a planned career development program to stimulate a new outlook on the P&E billet as a stepping-stone (rather than a stumbling block) position to further advancement.

Public works officers should rejuvenate interest in the maintenance management system, and the planning and estimating function, by emphasizing importance of maintenance management and planning and estimating to future promotions.

A briefing course should be developed and presented to interest young and aggressive craftsmen in planner and estimator jobs emphasizing the various P&E career path potentials.

The Chief of Naval O

THE 1972 BRONZE H

• Washington, D. C.

The Chief of Naval Operations, Admiral Elmo R. Zumwalt Jr., recently announced the winners of the Navy's first Self-Help Bronze Hammer Awards.

The Self-Help awards program was established by Admiral Zumwalt to recognize those Naval activities which have made the best use of their resources to improve personnel habitability ashore through their own efforts with the assistance of the Navy Seabees wherever possible.

The awards are based on the size, type, complexity and variety of projects. Also taken into consideration were the spread of benefits to the activity, its compliance with Department of Defense policy on habitability, the logic of its planning and the quality and permanence of the construction.

Four classifications for the Bronze Hammer Activity Award were established based upon the total enlisted strength of the activity, its tenants and the availability of a Naval Construction Battalion Unit (CBU) in the immediate area to assist the activity.

In addition to the activity awards, a special award category was established for Navy organizations, tenant activities, community groups, fleet units, etc., which do not have primary responsibility for real property management of personnel support facilities but made significant contributions to the Navy's Self-Help Program and were deserving of recognition. The four categories and winners of the Bronze Hammer Activity Award are:

Activities with an enlisted allowance greater than 1,000 and with a CBU in the immediate area. Eight nominees.

Winner: Naval Air Station, Miramar, California

The largest project under a wide-ranging Self-Help Program was the conversion of open bays in the Bachelor Enlisted Quarters to 240 rooms including drapes and new electrical fixtures. In addition, two new holes were added to the golf course complete with tees, greens, fairways and a lake. The "Self-Helpers" also improved parking areas, installed a storm sewer in the Navy Exchange area to improve drainage, prepared a site for a new bowling alley, built shelters for horses and a new corral at the horse stables and started work on a camping area and a new athletic field.

Runner-Up: Naval Air Station, Barbers Point, Hawaii

The "Self-Helpers" made extensive use of Seabees from CBU 413 to convert an abandoned dining hall into a gym, construct a Teen Center, build rooms in the enlisted quarters and start work on a new Auto Hobby Shop.

Activities with an enlisted allowance greater than 1,000 with no CBU in the immediate area. Eight nominees.

Winner: Naval Communications Station, Philippines

The program's participants completely rehabilitated the enlisted men's club without closing the facility. They rebuilt the roof, installed new floors, walls, ceilings and electrical wiring throughout. In the same time frame, they also started work on rehabilitating the enlisted quarters to provide modern, air conditioned rooms for its tenants.

Two Runners-Up: Naval Station Roosevelt Roads, Puerto Rico

Conducting a primarily after-hours program, the Self-Help work force accomplished a wide variety of projects during the year. Their accomplishments included refurbishing the Senior Petty Officers' Mess; improving recreation facilities in the Marine barracks; remodeling a dining hall; constructing boat slips at the marina; improving other recreational facilities such as ball fields, tennis courts, stables, the theater, and the skeet range.

Naval Air Station, Patuxent River, Maryland

An outstanding rapport with the Reserve Seabees in the area enabled the stations personnel to accomplish numerous projects during the year. Carefully coordinating all planning, administration and logistical requirements, they utilized the reserve Seabees to provide the technical expertise that propelled their program through projects that included rehabilitation and improvements to the sailing facilities, construction of a bridge walkway, improvements to recreational areas, a scout building, hobby shops and a pistol range.

Activities with an enlisted allowance less than 1,000 with a CBU in the immediate area. Six nominees.

Winner: Naval Weapons Station, Concord, California

These "Self-Helpers" continued their long established program operating under a junior officer of the Civil Engineer Corps and tapping the expertise of the Public Works civilians when needed. They upgraded the Marine barracks by installing drop ceilings and new lighting and converting the last remaining open-bay wing into rooms. They also constructed an Auto Hobby Shop and a Woodworking Shop utilizing repair of existing structures and construction of new buildings (some of which were obtained through excess listing, as were much of the equipment and tools to outfit the hobby shops). They also made improvements to the playground and the softball field.

RECOGN
OUTSTA
'SELF-H
PROGR
COMPL

l Operations Announces

HAMMER AWARDS

Two Runners-Up: Naval Torpedo Station, Keyport, Washington

Local volunteers provided quality improvements to their habitability by constructing rooms in the enlisted quarters, building social areas including a bar, and installing playgrounds and a picnic area. They established a game preserve which required the construction of a dam and spillway structure. They also made improvements to the commissary and started work on a small bore range, a trailer campground, ball fields and recreation areas.

Naval Ammunition Depot, Oahu, Hawaii

The Self-Help group converted a quonset building into a new Navy Exchange Store and built a new Navy Exchange Service Station. In addition to converting open bays to rooms in the enlisted quarters, they made improvements to the theater, swimming pool area, dining hall, beer garden and parking lots.

GNIZING
TANDING
-HELP'
GRAMS
PLETED

Activities with an enlisted allowance less than 1,000 with no CBU in the immediate area. Seven Nominees.

Winner: Naval Air Station, Fallon, Nevada

The do-it-themselves participants accomplished a wide range of projects including a temporary swimming pool for use until a permanent one could be built, the renovation of three guest houses, and the installation of modern lighting and the construction of a recreation room in the bachelor enlisted quarters. In addition, utilities serving the skeet range were upgraded and a trap range was constructed, horse corrals were constructed and a children's playground was installed. They also completed parking lot improvements, construction of bus stop shelters and the rehabilitation of the commissary store and the barber shop.

Runner-Up: Naval Security Group Activity, Todendorf, Germany

Although the smallest activity recommended in this category, it accomplished four high impact projects during the year. The first project was the conversion of a vacant room into a library which required painting and papering, outfitting the library with shelving and furniture, and cataloging over 2,000 volumes. In addition, the dining hall was refurbished, the lounge areas in the Bachelor Officers'/Chief Petty Officers' Quarters were converted into two separate lounges and clubs which can be combined to form a single large party room. The enlisted men's club is currently being enlarged to provide a game room, and work has been accomplished on the hobby shop, bookstore and enlisted lounge.

Special Awards

Winners: Supervisor of Shipbuilding, Conversion and Repair, Groton, Conn.

The "Self-Helpers" embarked upon a habitability improvement program for the World War II vintage areas used for berthing and messing crews during the period that their ships are undergoing overhaul at the yard. Improvements included installation of personnel lockers, air conditioning, spring-type bunks, improved lighting, deck repairs, individual messing chairs, improved head facilities and messing equipment. In addition, crews lounge areas and game rooms were constructed for use during off-duty hours.

Naval Air Reserve Unit, Lakehurst, New Jersey

Although a tenant command utilizing the air station's facilities, the Self-Help contingent obtained funding for and accomplished the renovation of the enlisted quarters assigned to them. The work included improvements to the entranceway, lobby areas, interior passageway, lounge areas and individual rooms. The improvements to the individual rooms included not only paneling, but new sinks, medicine cabinets and larger closet space.

Naval Security Group Activity, Azores

The volunteer workers of this activity demonstrated a high degree of ingenuity by constructing a 25' x 70' building from the footings up although they were unable to obtain Seabee expertise. The new building includes a general purpose room with fireplace, a kitchen, head, laundry and a patio with stone charcoal grills and drink cooler. The building serves the men working in this isolated area as a recreation building, club and snack bar. Improvements were also made to the enlisted quarters and the ball field.

Fighter Squadron Eleven, Oceana, Virginia

During a three-month period, the "Self-Helpers" erected three buildings for special services at NAS Oceana to use as an athletic equipment receiving station, a boat and recreational vehicle storage building and a hay barn for the horse stables.

Judging of the nominees was based upon evaluation of the effort made in the allocation of resources, the priority of attention given to personnel support, welfare and recreational facilities, the quality of completed improvements and the ingenuity exercised in the execution of the program.

Rear Admiral Walter M. Enger, CEC, USN, Chief of Navy Civil Engineers, administers the overall Navy Self-Help Program.

CONSERVATION OF ENERGY

By J. R. KOELLER
Utilities Division
Hq., Naval Facilities Engineering Command

• **Washington, D. C.**

The Director of the Office of Emergency Preparedness (OEP) has again advised the Department of Defense of anticipated electrical power problems, and has requested DOD to make every effort to conserve electrical power and other energy forms.

Based on this communication, the assistant secretary of defense (installations and logistics) sent a memorandum to the secretaries of the military departments requesting, "That each department and agency immediately issue positive energy conservation requirements for 1972 to each installation and in addition that each employee at each military installation be made aware of the current problems and his part in the total energy conservation effort."

This article is intended to provide information on the problem broader than that which is given in official instruction.

There is every indication that our energy problems will worsen over the next two decades. In 1970, 1,642 million megawatt hours of electricity were consumed in the United States. The projected consumption for 1990 is 5,978 million megawatt hours, an increase of 364%. The impact of this increase upon fuel consumption, investment dollars, and environmental considerations staggers the imagination. The following table shows where our electrical consumption rate has been and where it is headed. This is based upon data obtained from the Federal Power Commission.

UNITED STATES

YEAR	*SALES (000,000) KWH*	*PERCENT ANNUAL INCREASE*	*INDEX 1950 = 100%*
1950	280,539	—	100
1960	683,199	—	243
1961	720,728	5.5	260
1962	776,088	7.7	277
1963	830,811	7.1	296
1964	890,356	7.2	317
1965	953,414	7.1	340
1966	1,038,982	9.0	370
1967	1,107,023	6.5	395
1968	1,202,321	8.6	427
1969	1,307,178	8.7	466
1970	1,391,359	6.4	496
1990	5,978,000	6.7*	2,130

*Average annual projected increase 1970 - 1990. The average annual energy growth during the 1965 - 1970 period was 7.7%

The gross national product (GNP) can also be used as one general indicator of levels of national energy requirement. Between 1950 and 1965, the GNP, expressed in 1958 dollars, increased from 355 billion to 618 billion dollars, an average annual growth of 3.7%. In the period 1965 - 1970 the GNP increased annually in constant dollars 3.5%. Historical and projected increase in GNP and production of electricity are graphically displayed. Note that the electrical production is increasing at a faster rate than the GNP. This infers that the electrical slice of the GNP will continue to get bigger.

The reasons behind OEP's appeal are not appreciated by most Americans. Our standard of living is continuing to rise, and electrical brown-outs have not yet really affected us. For most persons, electrical and gas blackouts and other energy shortages are isolated and temporary disruptions. But, as the above projections show, the problem is getting bigger.

To quote Admiral Rickover: "The (energy) problem we face is probably the most serious since the inception of our Republic. Americans must change and adapt to the possibility that less energy must be consumed in order to save our resources. We are energy rich today, but find ourselves in the unenviable position of the prodigal son who lives luxuriously on his inheritance but after a brief moment of glory is left with nothing to his name."

Expansion Begets Problems

As a general matter, it is clear that the growth in electricity is closely related to the rate of national economic expansion and our standard of living. We may build a new plant, hire the people to run it, but until we have electricity to run the machines and furnish the lights, the plant is an economic waste. Today, with electrical demand out-stripping new electrical plant construction, measures must be taken to assure every KWH consumed is purposely used. Additional quantities of electricity cannot be provided quickly because from inception to production for a new electrical plant requires 6 to 8 years.

To increase our electrical generation 350% in 20 years requires the solution of some problems that are not easily solved.

First, the new dimensions of environmental protection are substantial problems that have long term implications. The associated technical, operating, administrative and revenue problems that still need to be solved require funds for R&D work, capital funds to finance environmental technology, capital funds for plant expansion and operating funds to administer, operate and maintain the new plants.

We are now also confronted with the declining availability of domestically-produced low sulphur fuels. We do not have a coal shortage, but most of our coal is not of the low sulphur content. In 1971 this nation consumed 5.5 billion barrels of oil, 511 million tons of coal, and 22 trillion cubic feet of natural gas. As compared to our 1971 consumption, the National Petroleum Council (NPC) projects that by 1980 we will

consume 800 million tons of coal. The NPC estimated that the limited availability of natural gas will not permit its utilization above the present level, and that the most significant change will be in our national oil consumption, increasing from 14.7 million barrels a day in 1970 to 22.5 million barrels a day in 1980.

The NPC also estimates that domestic production in 1980 will be only 12 million barrels a day. Thus almost half of our 1980 oil must come from foreign sources. The costs in terms of foreign exchange in 1980 will run between $12 and 15 billion a year.

Joseph Swindler, chairman of the New York State Public Service Commission, suggests that the NPC's projection of 22.5 million barrels per day consumption by 1980 is conservative. He estimated the consumption will be 28.3 mmbd. This implies that approximately 60% of the national oil requirement in 1980 would come from foreign sources. This equates to import of 6 billion barrels of oil a year (with a tanker arriving in a U.S. port every hour) at a foreign exchange cost of $20 billion per year.

This problem exists in most free countries. These countries will be bidding for oil from the same sources, chiefly from the middle east. The national security implications of dependence of the national economy on resources subject to interdiction is a matter for serious reflection.

But what about our other energy sources? First, hydro power cannot be increased significantly. Second, atomic power in long range appears to be the answer to our problem. But for the short term we have problems including: sites; lack of investor interest because return on investments is more attractive in other economic sectors; environmental; and the state of the art. All of these carry a price tag — if we want to buy. Unfortunately, for most of us, this is not a buyer's market. Most of us do not have any choice as to the type energy we buy or what we are willing to pay; we only have the choice of quantity.

What will the above problems cost the user? That is hard to say. Who can say what rate of return will entice investors to transfer their investment from another economic sector to electrical production to provide funding for a 350% increase in our electrical plant?

We can get some clues from the "state of art problems." It is estimated that $1 billion is requried annually to finance electrical R&D work. In the past, public utility commissions have been reluctant to allow R&D funding through the rate structures. As a result, utility companies were forced to restrict their R&D effort, and the state of the art suffered. Commissions are now becoming more lenient. But, how much R&D funding should be allowed in the rate structure?

If rates were increased 1 mil (one tenth of a cent) per kilowatt hour (KWH) consumed, $150 million would be available annually for R&D. The 1971 national residential average rate was 21 mils (2.1¢) per kwh, and the average consumption per person was 8,051 kwh. How much R&D are you willing to finance? What rate of return are you willing to pay investors? Remember, industrial users will recoup higher electrical rates by raising product prices. The electrical slice of government budgets will get bigger.

But, we have not touched on an apparently attractive alternative: curtailing growth of electricity production. If we curtailed our production of electricity, wouldn't most of our problems become insignificant? Let's not spend time on the impractical. We have already tied our economic growth and rising standard of living to the growth in the production of electricity. The majority of us want to improve our standard of living. In fact, to curtail electrical consumption means reversing our rising standard of living trend.

In addition, electricity is tied to the solution of many of our environmental problems. For example, a single customer of Tampa Electric Company engaged in recycling 350,000 cars in one year, used almost 90 million kilowatt hours of electricity in the process — an amount equivalent to a new city of 11,800 persons at an average consumption rate of 8,050 kwh. What about our growing population? Standing still economically, for each person we add to our population we need an additional 8,050 kwh. Also, as we consume more water and improve our sewage treatment we need more electricity in the process. Hence, to curtail electrical production means only a shifting in our problems or lowering our standard of living.

Conservation is Primary Objective

We have left many things unsaid, merely touching on a few problems in which we are all involved. The solution to these problems requires an input, no matter how small, from each of us. Cost reduction is a by-product of utility conservation; it is no longer the primary objective. *Conservation of the limited supply of domestically available low sulphur energy and electricity is now the primary objective.* Each one of us can contribute to the growth of our economy, the security of our country, and our rising living standard by taking steps to assure all energy consumed is used for some useful preplanned purpose.

Thus, it is important for all of us to learn about the navy's established utility conservation program, and to help the navy in its conservation efforts. In summary, let me quote Joseph C. Swindler, chairman, New York Public Service Commission: "I do not advocate a no-growth economy. Such an economy is neither feasible nor desirable, certainly as long as a large part of our population shares very little of the general affluence of the United States. I advocate only prudence in dealing with limited resources and dampening the flames of demand which it is no longer possible to satisfy without long-term damage to the energy resource position of the United States and the world and risk of serious environmental consequences . . . The time has come, it is overdue, to develop and put into effect a broad national program of energy conservation designed to stabilize the total consumption of energy at as early a time as is possible, consistent with avoidance of serious economic disruptions. Many users of energy are inexcusably wasteful in the light of this country's and the world's resource position. Others are of such small social and economic value as to be dispensable with minor social sacrifice".

ON ADVICE OF COUNSEL
INNOVATIVE PROCUREMENT

In some fields of government, such as education, the word "innovation" has become almost synonymous with the "good" or even merely the "sensible", because the traditional methods have come to be regarded as synonymous with fruitless failure. In fact, innovation would seem more often to disappoint, for traditional methods usually give some satisfaction; and changes require more attention to break custom and are as likely to worsen as to improve.

Random adjustments to a tuned engine are as likely to reduce as to improve performance. Such adjustments ought to be made (except as an act of desperation) only after thorough study of the facts and a profound understanding of the principles of the machine.

Government procurement, however, probably pays more than due respect to tradition as embodied in statutes, regulations, and the customary ways of buying. Yet, NAVFAC and other government construction agencies have in the last few years begun to use several innovative procurement methods.

Turn Key Construction Contracts

The term "turn key" suggests a divorce between the usual role of the government construction procurement agency in planning, designing, advertising, awarding, inspecting, and accepting at completion and the actual builder of a public work: so that the Government merely steps in at completion to pay the price and accept the keys to the work, much like a private home buyer. The private contractor designs and builds and the government merely pays the price at completion.

The divorce is not actually quite that thorough; for under NAVFAC "turn key" procedures the government sets forth detailed criteria for the structures and approves the plans, inspects and renders progress payments, and makes final payments upon final acceptance, but still behaves much like a private buyer from a speculative builder.

The advantages to be expected from this method of procurement are these: the builder can offer the structures he has been used to building, with whose problems and costs he is more or less familiar, rather than attempt to speculate as to what may be required by bulky government plans and specifications. The builder may exercise his ingenuity to plan for the most attractive product at the least cost.

The number of practicing builders is an assurance of a variety of different approaches not as likely from one architect-engineer designer. The builders may include a wider range than those usually bidding on government plans and specifications. Achievement of these advantages presupposes that builders are putting up structures comparable to those required by the government: military family housing — private speculative housing; BOQs and barracks — motels; office buildings.

Economy in Turn-Key Contracts

Savings by the "turn key" method were foretold by NAVFAC's experience in sometimes receiving offers of commercial products not conforming to the specifications but at very substantial savings. For example: Milspec boiler $38,845.00, commercial boiler same capacity $25,020.35; crane to Navy specs $141,779.00, commercial crane for same job $79,697.00.

"Loyalty to petrified opinion never yet broke a chain or freed a human soul." —*Mark Twain*

Experience demonstrated similar savings in the construction of family housing:

Low Bid	Rebid/(If any)	Turn Key/Award
$3,450,000	$3,238,000	$2,885,000
870,000		702,000
367,200		330,000
4,268,000		3,728,000

The monetary savings are easy to demonstrate but the question remains whether the product is as good. The private builders will offer a variety of sizes, arrangements and materials, even within the government criteria. Thus, to avoid builders focusing on and offering the cheapest and often the worst, awards must be negotiated so that non-monetary factors may be taken into account. Since these other factors cannot be determined precisely in advance and given mathematical weights, award is made after negotiation citing *10 U.S.C. 2304 (a)(10)* (competition impracticable).

At the time of providing this exception in the statute, Congress stated that it should be 'construed liberally'. Determinations under this authority are vested in contracting officers and are final. The comptroller general has now given his approval to use of the "turn key" method in family housing but acceptance sometimes has been grudging.

Multi-Year Contracting

Multi-year contracting for construction is simply a method whereby the needs of two or more years' work, some perhaps not yet authorized or appropriated for, are combined in a current contract for accomplishment. ASPR 1-322 provides for multi-year continuing contracts for supplies and services; and the appropriation acts for several years have permitted contracts for services and leases beginning at any time in the fiscal year and continuing for 12 months. Utility contracts may be awarded for up to ten years.

The hope is that, by multi-year contracts, construction or procurement economies may be effected or that appropriations for large projects may be spread over several years so as not to unbalance budgets. Construction economies occur when utility plants and services or roads and streets are laid out and built at once for an entire base, though only part will be built this year; or when construction camp and plant can be erected not only for present but also for foreseen future work. Procurement economies occur when the scale and long-term character of the work enable the contractor to set up prefabricating manufacturing plants or to make large buys that effect economies.

Multi-year contracting has been used in some sense for years. The layout and size of utility plants and systems has been based upon future and not merely present needs. Occasionally Congress has authorized projects looking to future needs, as to buy

long-lead-time machinery for a utility plant yet to be authorized. Sometimes projects, such as VLF Australia and the proposed DOD Office Building Anacostia, involve hundred's of millions of dollars, which simply cannot be financed all at once within budget guidelines without severe restrictions upon other work; so Congress has appropriated only part of the funds at the outset and work has been done in phases with options.

Restraints on Multi-Year Approach

Obstacles to multi-year contracting have been both legal and custom. Congress has authorized work only project-by-project; each project has usually had to be complete and useful in itself, and authority to contract without funds has been granted rarely. Unless expressly authorized, contracts cannot be made in excess of appropriations available and appropriations can only be used for the purposes for which they are made. Thus, no matter how necessary further work may be or what economies in construction or procurement may be foreseen, contracts must wait until Congress has authorized and appropriated funds for the work, usually year by year.

Congress may authorize contracts in advance of appropriation and may authorize and appropriate for work that will not result in a complete project, but has rarely done so. Procuring agencies may advertise for work beyond present authorizations and appropriations and may provide an option to incorporate the work upon later authorization and appropriations. Bidders and the contractors must discount the possibility the option may not be exercised. By foresight in the budgeting-authorizing-appropriating process many of the economies of multi-year contracting can be achieved, and more could be with authorizations to contracting for necessary future work as part of a current contract.

Management Contracts

The prime construction contractor may be little more than a manager of subcontractors. Contract clauses prescribing the minimum amount of site work that the prime contractor must perform may be necessary to ensure that the prime contractor does even some work, and anti-bid shopping provisions may be included in the IFB to assure fairness in the subcontracting process. The Government may find itself attempting to assure performance by subcontractors through a prime contractor whose interests are adverse.

Therefore, the idea has occurred to some procurement offices to hire a prime contractor as a construction manager to let and supervise the subcontract work on behalf of the Government. There will be no competition at the prime contract level, but there will be competition at the subcontract level. Through the construction manager acting for the Government, the Government may obtain more competition at the subcontract level where competition may count more in reducing costs.

The construction manager concept is taking a place in private construction, and the General Services Administration is using it to build several Government buildings. But the concept is not new; it was used by the Bureau of Yards and Docks years ago for the aborted "Big Dish" radio facility in West Virginia. There the site was limited upon one mountain top, designs were not ready for the whole work, and the subcontracts would be very large and much interrelated. The solution was to negotiate one over-all contract with a general contractor to provide common site services, supervision, and inspection and to award competitively bid purchase orders and subcontracts for the several parts of the work as designs were prepared. The concept worked well; but design difficulties and other means of obtaining the radio astronomy data caused the project to be discontinued.

Thus, a great variety of procurement devices can be used and adapted to satisfy particular needs. Where statutory exemptions and authorizations are necessary, these may be provided in the authorization statutes themselves. All that is needed is a willingness to look around for new ways and some cordiality of reception for the new ideas.

ABFC System Aids the Navy's Logistics Planning

By LCDR T. J. HEFFERNAN
CEC, USN

Early in World War II, logistics and tactical planners were faced with providing support to a constantly evolving tactical and strategic situation. Procuring and distributing the material required by military commanders while they were exploiting a changing military situation required an enormous effort by all levels to assure that nothing fell through the cracks.

Thus, the Navy Advanced Base Functional Components (ABFC) System, as a tool of naval logistics, was based on experience gained in early advanced base planning and shipment in World War II.

The *primary goal of the ABFC System is to provide comprehensive information to the planner — not in the actual delivery of hardware.* It is important to note the distinction between the ABFC System as a planning instrument and the actual hardware delivery systems which make the materials available. Each BUREAU/SYSCOM has its responsibilities and methods for providing material contributions; however, all use the ABFC System to identify Advanced Base requirements.

It must be emphasized that the ABFC is a *software system* of pre-engineered and pre-planned components in catalog form which permit the operational planner to identify logistic requirements without a new or special design in each situation. These components treat requirements on a functional basis defining needed facilities, equipment and manpower, both to construct and operate the component. Thus, knowing the mission to be performed, logistics support can be quickly and accurately defined to the material manager.

Today, there are approximately 300 ABFCs for which the Naval Facilities Engineering Command acts as NAVMAT's System Engineer. Since each component responds to a function, all systems commands and bureaus contribute within their technical or management specialty. Cognizant or lead responsibility is assigned on the basis of preponderance of input. For example, the M-Series now under design is medical, and accordingly, BUMED is the cognizant manager. Functional component designs include such areas as communications, aviation support, supply support, and administration.

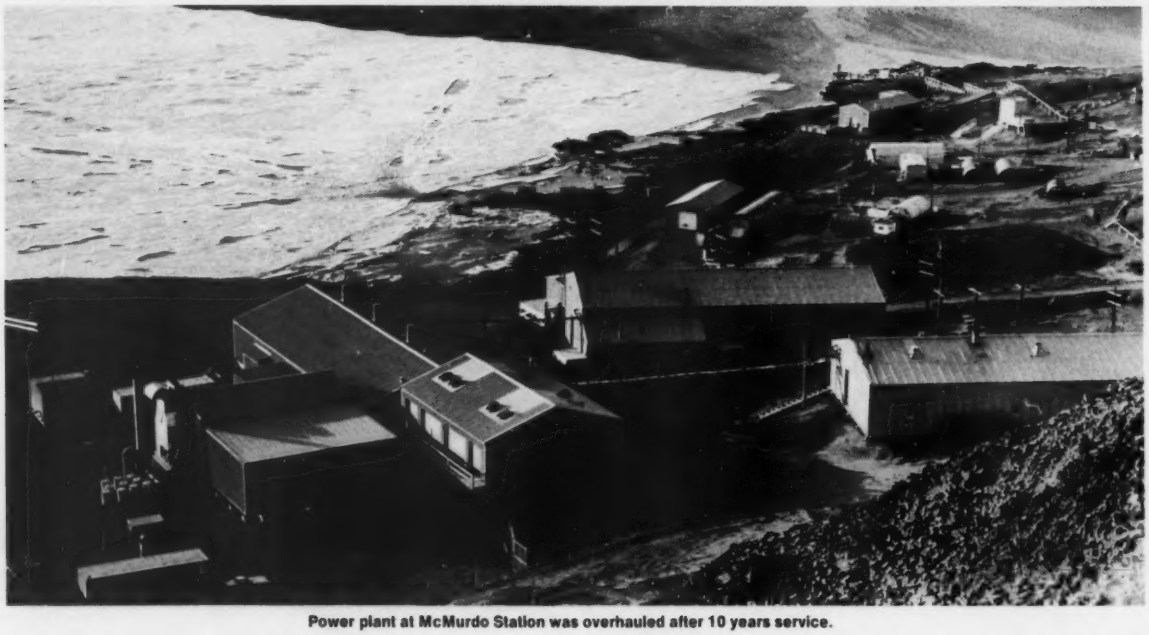
The ABFC System is not limited to contingency situations but also can serve in response to natural disaster or in stating the logistics requirements attendant to war plans.

It's in this last context that ABFC is often related to Prepositioned War Reserve Stock. The PWRS is material set aside for initial support of specific contingency plans. The ABFCs were used as shopping lists for much of this material. For many years, the ABFC System has not been given high priority by several SYSCOMS and bureaus. As a result, the present utility of the System is marginal. However, the requirement for the ABFC System remains valid. CNM has recognized the shortfall in support to the ABFC System and it appears that new emphasis will be placed on modernizing this Navy planning tool.

Operational Commanders must not only be aware of the existence and uses of this system but must actively demand that it be kept current both in technology and in the tactical and strategic concepts it must satisfy.

The quality of our planning always seems to be the first thing we can diminish when funding is restricted.

Seabees Overhaul McMurdo Power Plant



Power plant at McMurdo Station was overhauled after 10 years service.

By EOCS EDWIN D. GROOVER, USN
Operations Supervisor
Nuclear Power Plant, Antarctica

• Antarctica

The Navy's PM-3A nuclear power plant located at McMurdo Station, is in its tenth year of operation. It is operated by a crew of 23 enlisted personnel (Seabees and hospital corpsmen) and two Civil Engineer Corps officers. All have undergone at least two to three years of intensive training and experience in operation of nuclear power plants prior to being assigned to the PM-3A.

The unit provides both electric power and fresh water for McMurdo Station, whose population varies with the season from 150 to 1000 persons. Power is generated by a 2250KVA steam turbine-generator set and fresh water for the station is provided by three, 10 gpm, flash-evaporator, water distillation units. The saturated steam used in the plant is produced by a pressurized water nuclear reactor.

In January 1968, members of the Naval Nuclear Power Unit, which trains and supports the operating crew of the PM-3A, and a technical representative of the turbine manufacturer, inspected the turbine-generator set and determined that an overhaul was desired.

Completion time for the overhaul was set for January 1971. This three year lead time was allowed to provide sufficient time for proper planning as well as for procurement of long lead time materials.

While a three year lead time at first appeared very liberal, the planning, programming, and execution of this extensive overhaul proved it to be necessary.

The actual work performed consisted of replacement of the turbine rotor, nozzle block, inter-stage diaphragms, labyrinth seals, and the exciter bearings as well as complete maintenance on the remainder of the turbine-generator set. The fact that a major project of such technical intricacy was successfully carried out at a remote station such as McMurdo with its extreme environment is unusual in itself. Additionally, the overhaul was done entirely by Seabees instead of turbine specialists which should make the accomplishment significantly noteworthy.

Initial planning of the project included an inventory of the turbine-generator set components and all ancillary equipment. Development, by the critical path method, of a plan for accomplishment of the work was also devised. Responsibility for the entire project was assigned to a senior enlisted man who contacted the turbine manufacturer to identify potential problems, did the estimating for the development of the critical path plan, coordinated all material ordering and receipt, and supervised the actual overhaul at McMurdo Station.

When the material requirements were identified and the requisite materials placed on order, an intensive acquisition follow-up program was initiated. The follow-up program has been found to be an absolute requirement for major technical projects due to the 10,000 mile journey from manufacturer to the site. Materials were tracked, potential "lost" items identified and located, and all needed items shipped to the site by November 1970. Arrival of the material six weeks before the actual overhaul date gave assigned personnel the opportunity to lay out, inspect, clean, and prepare each part for installation on the turbine-generator.

The turbine itself is a nine stage condensing unit, utilizing a vertical overhead exhaust trunk for transporting exhaust steam to the plant's four air-cooled condensers. As a preparatory step, the exhaust trunk, 24 inches in diameter, was flame cut and a set of flanges were installed to ease the burden of moving equipment during subsequent inspections and overhauls. While this work was progressing, other members of the overhaul crew dismantled other parts of the unit and fabricated necessary special equipment to handle the five ton upper half of the turbine casing.

Upon successful removal and inverting of the upper half of the turbine casing, the turbine rotor was removed and the inter-stage diaphragms were removed from the upper and lower casings without undue difficulty. The next step, removal of the turbine nozzle blocks, proved to be quite difficult. However, by utilizing some of the more sophisticated instruments of the Seabee trades — hydraulic jacks, jack hammers,

and an oxy-acetylene torch — the maintenance crew finally extracted the nozzle blocks.

Prior to the overhaul, it was noted that a steam leak had developed at the high pressure end of the turbine casing flanges. The steam cuts, which had resulted from the leak, were filled with liquid steel, allowed to cure for 24 hours, and polished with a hone and crocus cloth.

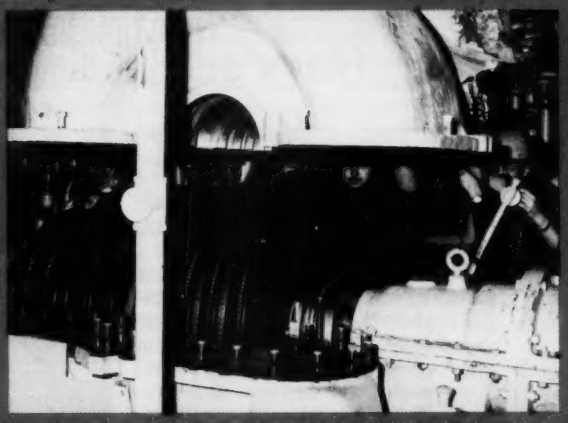
Upon completion of polishing and cleaning, the installation of new diaphragms and nozzle blocks was started. This phase of the overhaul went along very smoothly, with the crew machining crush pins and adjustment blocks as needed. Upon completion of installation of all the diaphragms, the new rotor was installed. At that time it was noted, with considerable concern, that the clearances between the rotor and diaphragms were not as originally designed. When the original diaphragms were machined, the shop notes had not been incorporated into the "as built" drawings. This resulted in a discrepancy of about 0.070 inch on stages 2 through 9 of the turbine.

The overhaul was immediately halted and contact was made with both the turbine manufacturer and Naval Facilities Engineering Command to ascertain the extent of the difficulty which could result from this clearance problem. It was estimated that the turbine would operate satisfactorily, but that there would be a loss of efficiency of about 1-2%. Since the nearest machine shop was some 2,375 miles away in New Zealand, it was decided to proceed, and, upon completion of the overhaul, to perform certain tests prescribed by the manufacturer.

During final assembly, the governor was completely overhauled, the oil sump and system thoroughly cleaned, the oil conditioner refilled with new oil, all bearings checked for clearances and wear patterns, the trip and throttle valve overhauled, all mechanisms having an oil boundary rehabilitated to provide better control, and all piping and equipment restored.

Upon completion of the overhaul, the reactor was brought to the critical stage, the secondary system raised to operating temperature and the turbine "rolled". All required tests were performed satisfactorily on the turbine and it was once again in service supplying McMurdo Station with heat and light.

The success of the overhaul project is attested to by the fact that during the "DEEP FREEZE" winter of 1971, immediately subsequent to the turbine-generator repair, the PM-3A set a new military nuclear power plant continuous operating record of 4400 hours, or more than six months.



Special equipment was fabricated by the Seabee crew to assist handling of the five ton upper section of the turbine casing during its removal and replacement.

EOCS Groover (left) and UT1 Sykes guide replacement of the turbine rotor into position, where a clearance discrepancy was discovered, but determined to be within tolerance.

Antarctic Diesel Power Plant Improved

By J. N. AGNOS
Design Division
Electrical Engineering Branch, NAVFAC
• Washington, D. C.

NAVFAC Headquarters (04) has completed the design for the modification and expansion of the diesel power plant at McMurdo Station, Antarctica. Materials and equipment are being procured by CBC Davisville, R.I. for construction during the next austral summer construction season.

The diesel power plant is one of the two power units serving the station. The other is the PM-3A nuclear plant. The diesel unit was designed by NAVFAC Headquarters and constructed by the Seabees. It has been in operation since 1965. It generates power at 4160 volts and its present installed capacity is 2000 KW (2500 KVA).

The present expansion of the diesel plant will increase its installed capacity to 3000 KW (3750 KVA) and its firm capacity to 2500 KW (3125 KVA). This represents a 50% increase in installed capacity, a 66% increase in firm capacity, and a 33% increase in continuous operating duty firm capacity.

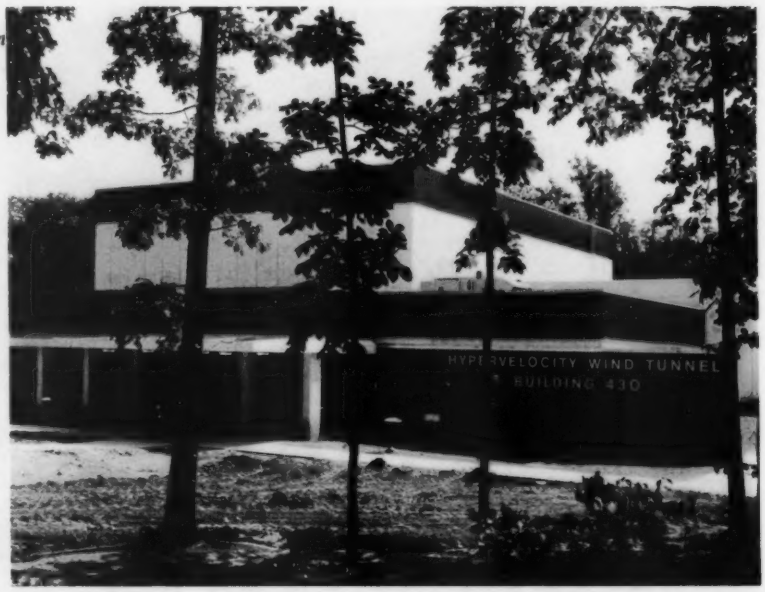
The indicated difference of the continuous operating duty firm capacity in comparison with the firm capacity (normal mode) is due to the operational requirements for remote stations which require two units on stand-by in lieu of one as is the case for power plants operating under normal conditions.

It is anticipated that this expansion of the diesel power plant will be sufficient to meet present and projected future power demands of the station.

The expansion of diesel power not only will enable the plant to meet present and projected future power demands, but with a central control and dispatching office in the expanded power plant building, and some modifications to the relaying system, the two power plants could be operated in parallel if needed and better control of power dispatching could be achieved.

Navy's HYPERVELOCITY Wind Tunnel

By CDR. HUGH A. CRISP, CEC, USN
Resident Officer In Charge of Construction
Naval Ordnance Laboratory
• Whiteoak, Md.



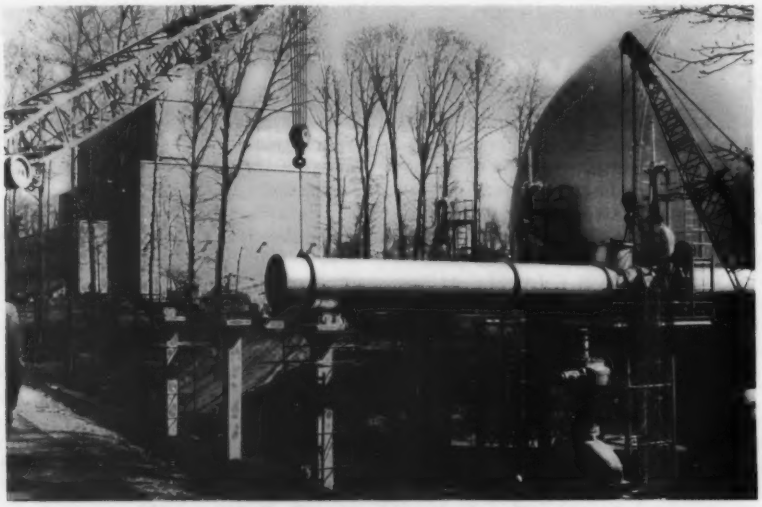
The hypervelocity wind tunnel at the Naval Ordnance Laboratory is one of a special class of research facilities that the Chesapeake Division, Naval Facilities Engineering Command has been responsible for designing and building in the Washington area. There are several Navy research and development laboratories in the general vicinity with requirements for research facilities which tax the abilities of the designer and builder alike.

The hypervelocity wind tunnel is such a facility.

The Hypervelocity Wind Tunnel was authorized and funded with the FY 1967 military construction program. The facility when completed will give scientists the ability to model boundary layer flow at high mach numbers and high Reynolds numbers. In layman's terms, a Reynolds number is a function of the density of the fluid through which the capsule moves. Manned space vehicle scientists think in terms of a capsule starting in atmosphere, accelerating to maximum velocity in space, being slowed down to the minimum velocity possible prior to reentry and being lowered gently to earth.

Missile designers, on the other hand, think in terms of a missile accelerating rapidly in the atmosphere, attaining high velocities in space, and returning to earth at high velocities. This means that missile designers need to model fluid boundary layers at high mach numbers in a dense fluid, the atmosphere. Figure 1 shows the envelope enclosing all existing wind tunnels in the United States with a one foot diameter test section or greater and the operating envelope of the new hypervelocity tunnel. The new tunnel will have a five foot diameter test section, and scientists will be able to vary the angle of attack of the model during test through 60 degrees of arc.

Figure 2 shows a cutaway diagram of the wind tunnel system. The tunnel will operate as follows: 15,000 p.s.i. nitrogen gas will be taken from an existing bottle farm and compressed to 45,000 p.s.i. in three single stage compressors. This gas will be discharged into three gas driver vessels. Prior to initiation of a run, this gas will be heated to 300° F by heaters in the vessels by which process pressure in the vessels will be increased to 60,000 p.s.i. To inititate a run, cold nitrogen gas at 15,000 p.s.i. will be placed in gas heater vessels. Taking the mach 20 leg as an example for temperatures and pressures, this gas will be heated to 5,000° F, at which time the pressure will be about 45,000 p.s.i. To initiate the run, a series of diaphragm disks at the downstream end of the heater vessel will be ruptured allowing the gas to enter the nozzle which has been very accurately contoured. When the disks rupture, an electrical signal will open the high pressure control valves at the downstream end of the gas driver vessels and 60,000 p.s.i., 300° gas will push the 45,000 p.s.i., 5,000° gas through the system into the vacuum sphere.



Diffuser pipe being placed into position for connection to test cell.

The duration of the run after rupture of the diaphragms will be from one to four seconds. During this time, scientists will be able to get a complete pressure distribution in the boundary layer about the model, and photograph the actual configuration of the flow.

The total cost of the building and basic system will be about $7½ million.

In undertaking and accomplishing this difficult engineering task, unusual problems were encountered:

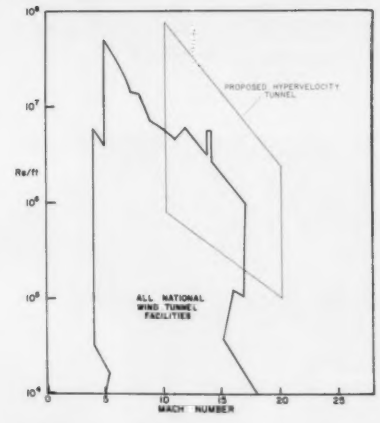


FIGURE 1 — Reynolds Vs. Mach Number simulation capability suitable for developmental testing with test section greater than one foot diameter (log scale).

Design of the Gas Driver Vessels. These vessels must hold 60,000 p.s.i. at 300° F. They were designed as thick-walled cylinders, meaning that an even stress distribution across the wall of the cylinder could not be assumed. The design solution decided upon for this application was to construct two cylinders and shrink-fit one into the other. To further improve the stress distribution under load, each cylinder was autofrettaged prior to the shrink fitting. Autofrettage is a pre-stress process historically used in the manufacture of gun barrels, in which the inner layers of the pressure vessel are stressed beyond the elastic limit; this in effect places these layers in compression at the start of the normal loading cycle.

Test of the High Pressure Piping System. Several of the components of the system are connected by piping which must withstand up to 60,000 p.s.i. pressure and because some of the elements within the system are to be constructed of carbon and graphite it is absolutely necessary that the system be clean.

High pressure fittings and connections individually tested and certified for the rated pressures are available commercially. The normal practice in the industry however, is to actually test only one length of pipe in ten. It was decided that the safest test procedure for the assembled piping would be a hydrostatic test. Distilled water was used as the test fluid and the system was sectionalized and tested to over 70,000 p.s.i. Following the test, the system was purged with Freon MF and filled with dry nitrogen. Freon is a solvent. Its boiling point at atmospheric pressure is about 75°. By pulling a slight vacuum on the system after purging, all traces of the Freon could be removed.

Material Specifications for the High Pressure Manifolds. The high pressure manifolds are two rectangular prisms which will be placed on each side of the high pressure control valves. They must withstand up to 60,000 p.s.i. pressure. A four inch hole will be drilled longitudinally through the prism and 2½ inch holes will intersect this hole at nine locations along the prism. The points of maximum stress can be predicted to be the hole intersections, and because of the brittle fatigue problem associated with high pressure vessels, there is a limit to the tensile strength of the material that can be used; in this case that limit was established at about 125,000 p.s.i.

In practical terms, that means that the stress levels expected at the hole intersections will exceed the elastic limit of the material. The specifications required the contractor to design for 20,000 cycles rather than the endurance limit. In addition, an arc remelted steel was specified because it is a cleaner steel and it was believed that it would contain fewer and smaller inclusions to act as stress concentrators. Finally, test blocks will be taken and machined from the manifold forging. These will be cycled to failure to substantiate the design analysis. (As an aside, a fairly exacting military specification on ultrasonic testing is available for reference, MIL-I-8950B dated 18 September 1968. This specification seems to have wide acceptance in industry.)

The building is now complete and some offices within are being used. The vacuum sphere is complete and is cross-connected to existing wind tunnels to provide them with extended capacity. The telescoping diffuser pipes for the mach 10 and mach 15 legs are in place. The compressor system, the gas driver vessels, and much of the high pressure piping is installed and the piping has been tested. The heater vessels are presently scheduled for delivery with remaining components expected by 1 February 1973. It is hoped to complete assembly of the system soon thereafter so that it can be available for test work in the spring of 1973.

The conceptual planning for the new hypervelocity wind tunnel was done in the aero and hydroballistics directorate at the Naval Ordnance Laboratory.

Scientists and engineers from the laboratory prepared supporting documentation and presented it to reviewing authorities in the navy and the Congress to convince them that the tunnel could be built and was needed to be built.

The aero and hydroballistcs directorate has assigned a project manager for the tunnel to coordinate the expression of the requirement to the builders, and to provide technical advice on the critical areas of construction and manufacturing. The laboratory has also provided technical advice on critical machining processes and metallurgical problems and will design the control system and test instrumentation.

The Chesapeake Division has been the construction agent for the building and major system components. The public works department is installing the finished components into the basic system. System test, instrumentation and calibration will be the responsibility of the aero and hydroballistics directorate. Close coordination and good cooperation between the participating organizations is the key requirement to success in constructing such technically complex facilities.

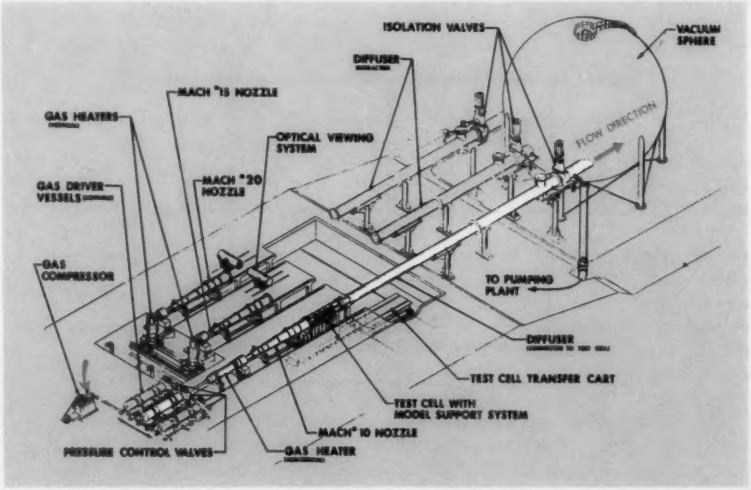
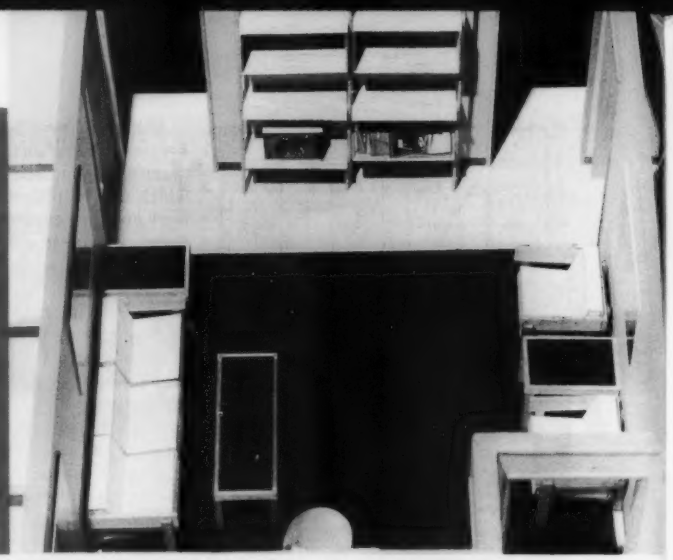


FIGURE 2 — Cutaway diagram of wind tunnel system showing simplified sequence of operation and flow direction.

NEW BEQ In '72



Bird's eyeview of decor and furnishings in the 12-man living room of new BEQs. Main entrance to suite is at lower right. Within are four 3-man bedrooms off the living room.

• Philadelphia, Pa.

The Northern Division of the Naval Facilities Engineering Command has awarded a $1,869,000 contract to the Hope Building Co., Inc., of Cranston, R.I., for construction of a bachelor enlisted quarters at the Naval Base, Newport, R.I., to be completed in March 1973.

The new BEQ will consist of two 3-story buildings to house 504 men in apartment-type quarters. Each apartment will house 12 men in four 3-man bedrooms grouped around their own private living room. Each of the 3-man bedrooms has its own private bath.

The steel-frame buildings will have brick veneer exteriors and outside semi-enclosed stair towers with stucco finish. Full exterior balconies will take the place of the usual inside corridors.

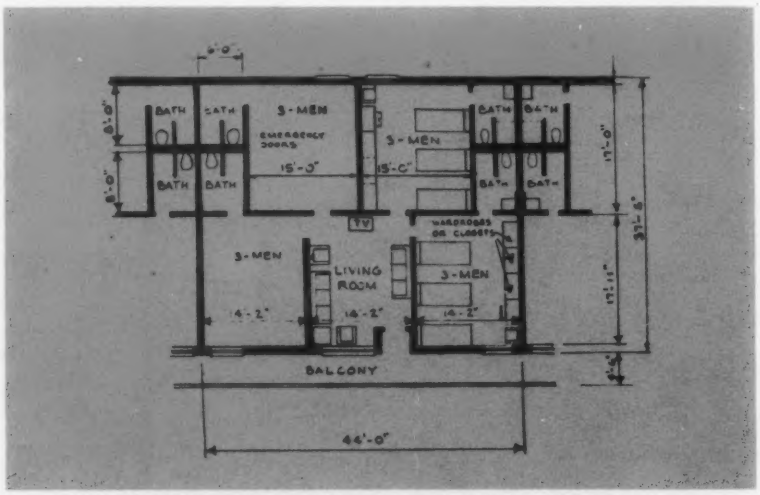
The design employs a modular concept, permitting any number of 43-foot bedroom and livingroom modules to be included to achieve a structure of any desired size.

The design increases the space provided for each occupant from 72 to 85 square feet in each bedroom, and from 6 square feet for each man in a central lounge to 20 square feet per man in private living rooms.

The Navy is thus able to meet the full DOD habitability criteria within the congressional cost limitations, with adequate privacy and a homelike atmosphere not previously afforded by Navy BEQ's.

This new apartment-type concept was developed by the architectural-engineering firm of Welton Becket and Associates, working in conjunction with NAVFAC.

The first BEQ with the new features was a 552-man BEQ started at the Naval Air Station, Corpus Christi, Texas, with completion scheduled for August 1972. Thirty more new BEQs to provide housing for over 14,000 men are scheduled for this year. The current five-year construction program will provide quarters for an additional 41,000 men.



Typical 12-man interior module with one private bath for each 3-man room, where funds permit.

During the remainder of 1972, construction of the new BEQs is planned for the following locations (number of occupants in parentheses):

Naval Station, Adak, Alaska (336); Naval Air Station, Agana, Guam (312); Naval Air Station, Barbers Point, Hawaii (480); Naval Hospital, Charleston, S.C. (204); Naval Auxiliary Air Station, Fallon, Nev. (504); Naval Air Station, Glynco, Ga. (108); Service Schools, Great Lakes, Ill. (540); Naval Magazine, Guam (156); Naval Station, Guantanamo, Cuba (492); Naval Air Station, Jacksonville, Fla. (672); Naval Torpedo Station, Keyport, Wash. (60); Naval Amphibious Base, Little Creek, Va. (504).

Naval Hospital, Memphis, Tenn. (72); Naval Air Station, Meridian, Miss. (576); Naval Air Station, Miramar, Calif. (852); Naval Submarine Medical Center, New London, Conn. (156); Naval Station, Newport, R.I. (504); Commander in Chief Atlantic, Norfolk, Va. (120); Naval Communication Station, Norfolk, Va. (180); Naval Station, Norfolk, Va. (108); Naval Air Station, North Island, Calif. (756); Naval Training Center, Orlando, Fla. (2000).

Naval Station, Pearl Harbor, Hawaii (780); Naval Air Station, Pensacola, Fla. (two barracks for 600 and 1008); Naval Station, Philadelphia, Pa., (504); Naval Station, Roosevelt Roads, Puerto Rico (792); Naval Station, San Diego, Calif. (444); Naval Training Center, San Diego, Calif. (300) and Naval Weapons Station, Yorktown, Va. (240).

Revitalizing Phnom Penh's Port

Existing railroad pier before [illegible] to hazardous cargo facility at [illegible] Tonle Sap River, six km. north of Phnom

By LCDR G. R. GILMORE, CEC, USN
Director of Construction, Cambodia

• **Phnom Penh, Cambodia**

Cambodia is a country at war. This is clearly evident in the capital city of Phnom Penh where tanks clatter through the street enroute to the not too distant war. Window panes shudder from exploding bombs dropped on nearby enemy concentrations. Pochentong airport is occasionally closed by hostile rocket fire.

On March 18, 1970, Prince Sihanouk, the country's leader, was ousted and the new government resolved to settle the Communist problem by diplomatic means; but within 10 days the North Vietnamese launched an offensive at Phnom Penh. At the request of the Cambodian government, South Vietnamese units joined in the battle to halt the NVA advance and provide the Cambodians time to mobilize.

On October 7, 1970, the Cambodian monarchy was officially abolished and the nation was proclaimed the Khmer Republic. The mobilized nation committed itself to driving the North Vietnamese back across the border.

External military and economic aid was needed to prosecute the war and sustain the people. Many countries, including the United States, responded. United States military troops were not requested.

During the summer of 1971 it appeared questionable that the port of Phnom Penh could handle the expected influx of aid materials. The Officer-in-Charge of Construction, Thailand was requested to determine if the port could handle a monthly throughput of 60,000 metric tons (66,000 U.S. tons) of cargo per month.

The consulting engineer firm of King & Gavaris was engaged by the OICC to perform the study. In July, after extensive field investigations, the firm submitted its preliminary report.

It was found that the majority of cargo in Phnom Penh was being handled manually at most of the piers. The exception was at berths 4 and 5, on the high-level, platform-type marginal wharf. Trucks were able to drive onto these piers and be loaded directly, utilizing ship's gear. During the three month dry season, however, the water level drops substantially (about 10 meters or 32 feet) making the ship's gear unusable. Mobile cranes on the piers or manual labor must then be used.

Hazardous cargo was also being offloaded at these berths creating a potential problem of significant magnitude, since the berths are near the central part of Phnom Penh.

Berths, 1, 2, and 3 consist of floating platforms 45 meters long and 12 meters wide (145'x39') mounted on a series of steel pontoons. The pontoons are not accessible by truck so all cargo must be manhandled by male and female stevedores.

King & Gavaris concluded, however, that the port could accommodate the expected throughput if certain facility modifications were made and cargo handling procedures improved. Basically the recommendations were as follows:

Civil Port

a. Utilize the port only for general cargo.
b. Accomplish minor structural repairs to berths 4 & 5 and moderate repairs to berths 1, 2 and 3.
c. Install improved lighting to facilitate multi-shift operations.
d. Install conveyors at berths 1, 2 and 3 to move the cargo from the pontoons to the dock.
e. Purchase materials-handling equipment including cranes, forklifts and a tug, and establish a preventive maintenance and training program.
f. Improve cargo processing procedures in the warehouse and customs areas.

Hazardous Cargo Pier

a. Utilize an existing railroad pier six kilometers north of the city on the Tonle Sap river.
b. Remove the rails from the pier and convert to a truck operation.
c. Construct a new access road and truck staging area.
d. Illuminate the area for multi-ship operations.
e. Provide cargo handling equipment and training similar to that which was recommended for the civil port.

The recommendations provided an economical solution to the port throughput problem and were capable of implementation within a reasonable time. The engineering report was approved by the Military Equipment Delivery Team for Cambodia (MEDTC) and the American Embassy at Phnom Penh. Programming of the work was started immediately.

During the summer months, Lt. John Franz, CEC, USN, represented the OICC, Thailand in Phnom Penh and coordinated the engineering surveys. He also accomplished some of the preliminary work with the Khmer authorities in preparation for construction operations.

Lt. Franz was relieved in October 1971 by LCdr Gordon Gilmore, CEC, USN, who was assigned as the Director of Construction, Cambodia. A modest sized, but well-qualified staff of Cambodians and one Thai national was organized and the procedures for contracting in Cambodia were finalized with the Khmer government.

On November 9, 1971, the first phase of the port improvement work was placed under contract. It included the conversion of the railroad pier facility for the handling and processing of hazardous cargo. The contract was awarded to one of the leading Cambodian contractors, Chrun You Hak and Brothers, at a price of $237,539.00.

Due to the critical nature of the hazardous cargo facility, Ambassador Swank and the Chief, MEDTC were most interested in its early completion. The Ambassador participated in the signing of the contract and then he and the Deputy Chief of Mission, Mr. Thomas Enders, accompanied OICC and contractor personnel on an inspection of the job site.

Completion was scheduled for February 1972.

Reproduced below is a summary of the responses received from *The Navy Civil Engineer's* quadrennial Reader's Survey completed 15 September 1972. The survey resulted in 507 individual voluntary responses of which 319 contained signatures. Space does not permit a summation of the interesting suggestions or remarks offered by those responding, however those desiring the complete study may request copies from the Editor or inspect it in the editorial offices.

1972 READERS SURVEY

NAVY CIVIL ENGINEER

I AM { 148 USN 112 USNR 96 USNR (Inactive); 41 Civilian Employee; 0 Paid Subscriber; 7 Other _____ }

I AM ASSIGNED TO { 4 NAVFAC; 19 EFD; 23 PWC; 39 SEABEE; 83 OTHER (specify 83 VARIED); 17 ROICC; 17 STAFF; 60 RESERVE; 9 CBC }

MY GRADE IS 1 RADM; 21 CAPTS; 66 CDRS; 71 LCDRS; 82 LTS; 45 LTJGS; 24 ENS; 8 WOs; 3 ENL; 78 CIVILIAN
(Rank, GS-)

I have 16 Av ___ years of accredited education (elementary, high school, college).
I hold a _____ degree in 291 Bachelors; 102 Masters; 25 Doctors.
I have 12 Av ___ years of government service (civilian and armed forces combined).
I have/have not contributed articles or material to The Navy Civil Engineer. Have: 59 Have Not: 337
I have been a reader of The Navy Civil Engineer for _____ years.
I usually read: 97 all; 220 more than half; 68 less than half; 18 hardly any of the contents of The Navy Civil Engineer.

MY RATING OF THE MAGAZINE

	Excellent	Good	Fair	Poor
My *overall* opinion is	132	227	30	6
and of editorial content	128	178	35	4
and of format	172	156	23	3
and of page design	160	167	52	2
and of photographs	168	169	58	7
and of printing and paper stock	156	162	21	4
and of mailing and distribution	152	138	37	29

DELIVERY AND AVAILABILITY

326 I receive my copy through the mail.
It arrives in good condition.
It does not arrive in good condition.
47 I receive my copy through Navy distribution channels.
Copies are easily and readily received.
Copies are not easily obtained.
1 I read my copy in a library or other central source.
The copy I read is shared with _____ others.

OF THE STANDING FEATURES

	I READ	DON'T READ
Speaking from Topside	301	46
On Advice of Counsel	237	89
About People	293	37

ARTICLE PREFERENCES

	I LIKE	DON'T LIKE
Research and Development	264	51
Management	284	38
Educational and Professional Development	281	32
Engineering and Construction	311	15
Technical Articles	244	59
Seabee Operations	281	33
Utilities	154	101
Reserves	196	117

FREQUENCY

I prefer to receive the magazine
185 Monthly
99 Bi-monthly
71 Quarterly
2 NEVER

Independent of *The Navy Civil Engineer Reader Survey*, was a questionnaire directed 28 August 1972 to 100 selected CEC active duty officers and to 100 selected CEC inactive duty officers by the Public Affairs Office, Headquarters, Naval Facilities Engineering Command. Of the 200 inquiries dispatched 116 were returned. Sub-totals of both surveys will not necessary agree with the total as not all respondees answered all individual questions or points of inquiry.

1. Do you regularly receive your copy of the Navy Civil Engineer?
   - A. Yes 59
   - B. No, not regularly 20
   - C. I never receive the magazine 31

2. To what extent, typically, do you read the Navy Civil Engineer?
   - A. Avidly, almost literally from cover to cover 13
   - B. Articles of special personal interest only 47
   - C. Skim through magazine 21
   - D. Rarely read anything 0

3. Do you consider the Navy Civil Engineer to be worthwhile and interesting?
   - A. Yes 56
   - B. No 4
   - C. Sometimes 24

4. Do you feel that the Navy Civil Engineer enhances your professional development and increases your job knowledge as a Civil Engineer Corps officer?
   - A. Yes, decidedly so 6
   - B. Yes, to some extent 42
   - C. Yes, but only minimally 32
   - D. No, not at all 3

5. Do you think the length of the Navy Civil Engineer is appropriate?
   - A. Yes, just right 62
   - B. No, too long 5
   - C. No, too short 12

6. Would you prefer the Navy Civil Engineer to be more a newsletter, and less an essay magazine?
   - A. Yes, I prefer a newsletter 7
   - B. No, I prefer the present format 47
   - C. I am indifferent between the two 13

7. If the Navy Civil Engineer were a newsletter, how frequently should it be published?
   - A. Monthly 48
   - B. Bi-monthly 13
   - C. Quarterly 4
   - D. Semi-annually 1
   - E. Annually 1

8. If the Navy Civil Engineer could be continued in its present format only by charging subscribers a fee, what is the maximum you would be willing to pay?
   - A. Nothing. I would not subscribe 21
   - B. No more than $3.00 per year 40
   - C. Between $3.00 - $5.00 per year 13
   - D. Between $5.00 - $10.00 per year 2

Reproduced below is a summary of the responses received from *The Navy Civil Engineer's* quadrennial Reader's Survey completed 15 September 1972. The survey resulted in 507 individual voluntary responses of which 319 contained signatures. Space does not permit a summation of the interesting suggestions or remarks offered by those responding, however those desiring the complete study may request copies from the Editor or inspect it in the editorial offices.

1972 READERS SURVEY

NAVY CIVIL ENGINEER

I AM { 148 USN 113 USNR 96 USNR (Inactive); 91 Civilian Employee; 0 Paid Subscriber ☐ 7 Other _____ }

I AM ASSIGNED TO { 4 NAVFAC 17 ROICC; 19 EFD 17 STAFF; 23 PWC 40 RESERVE; 39 SEABEE 9 CBC; 83 OTHER (specify 83 VARIED) }

MY GRADE IS 1 RADM; 21 CAPTS; 66 CDRS; 71 LCDRS; 87 LTS; 46 LTJGS; 24 ENS; 8 WOs; 3 EMs; 28 CIVILIAN
(Rank, GS-)

I have 16 AV years of accredited education (elementary, high school, college).
I hold a _____ degree in 291 BACHELORS; 102 MASTERS; 25 DOCTORS.
I have 12 AV years of government service (civilian and armed forces combined).
I have/have not contributed articles or material to The Navy Civil Engineer. HAVE: 59 HAVE NOT: 337
I have been a reader of The Navy Civil Engineer for _____ years.
I usually read 87 all; 220 more than half; 68 less than half; 18 hardly any of the contents of The Navy Civil Engineer.

MY RATING OF THE MAGAZINE

	Excellent	Good	Fair	Poor
My *overall* opinion is	132	327	30	6
and of editorial content	128	178	35	4
and of format	172	156	23	3
and of page design	160	167	52	2
and of photographs	168	149	58	7
and of printing and paper stock	156	162	21	4
and of mailing and distribution	152	138	37	29

DELIVERY AND AVAILABILITY

320 I receive my copy through the mail.
It arrives in good condition.
It does not arrive in good condition.
47 I receive my copy through Navy distribution channels.
Copies are easily and readily received.
Copies are not easily obtained.
1 I read my copy in a library or other central source.
The copy I read is shared with _____ others.

OF THE STANDING FEATURES

	I READ	DON'T READ
Speaking from Topside	301	46
On Advice of Counsel	237	89
About People	293	37

ARTICLE PREFERENCES

	I LIKE	DON'T LIKE
Research and Development	264	51
Management	284	38
Educational and Professional Development	281	32
Engineering and Construction	311	15
Technical Articles	244	59
Seabee Operations	281	33
Utilities	154	101
Reserves	196	117

FREQUENCY

I prefer to receive the magazine
185 Monthly
99 Bi-monthly
71 Quarterly
2 NEVER

Independent of *The Navy Civil Engineer Reader Survey*, was a questionnaire directed 28 August 1972 to 100 selected CEC active duty officers and to 100 selected CEC inactive duty officers by the Public Affairs Office, Headquarters, Naval Facilities Engineering Command. Of the 200 inquiries dispatched 116 were returned. Sub-totals of both surveys will not necessary agree with the total as not all respondees answered all individual questions or points of inquiry.

1. Do you regularly receive your copy of the Navy Civil Engineer?
   - A. Yes 59
   - B. No, not regularly 20
   - C. I never receive the magazine 31

2. To what extent, typically, do you read the Navy Civil Engineer?
   - A. Avidly, almost literally from cover to cover 13
   - B. Articles of special personal interest only 47
   - C. Skim through magazine 21
   - D. Rarely read anything 0

3. Do you consider the Navy Civil Engineer to be worthwhile and interesting?
   - A. Yes 56
   - B. No 4
   - C. Sometimes 24

4. Do you feel that the Navy Civil Engineer enhances your professional development and increases your job knowledge as a Civil Engineer Corps officer?
   - A. Yes, decidedly so 6
   - B. Yes, to some extent 42
   - C. Yes, but only minimally 32
   - D. No, not at all 3

5. Do you think the length of the Navy Civil Engineer is appropriate?
   - A. Yes, just right 62
   - B. No, too long 5
   - C. No, too short 12

6. Would you prefer the Navy Civil Engineer to be more a newsletter, and less an essay magazine?
   - A. Yes, I prefer a newsletter 7
   - B. No, I prefer the present format 47
   - C. I am indifferent between the two 13

7. If the Navy Civil Engineer were a newsletter, how frequently should it be published?
   - A. Monthly 48
   - B. Bi-monthly 13
   - C. Quarterly 4
   - D. Semi-annually 1
   - E. Annually 1

8. If the Navy Civil Engineer could be continued in its present format only by charging subscribers a fee, what is the maximum you would be willing to pay?
   - A. Nothing. I would not subscribe 21
   - B. No more than $3.00 per year 40
   - C. Between $3.00 - $5.00 per year 13
   - D. Between $5.00 - $10.00 per year 2

NAVY CIVIL ENGINEER INDEX

This index of articles appearing in The Navy Civil Engineer in 1972 is published for reference purposes. The first section of the index is by edition with an alphabetic listing by author. The second section lists articles alphabetically under general categories with edition date and page number shown.

FIRST SECTION

January 1972

MURPHY, T. C. ..... The Young Officer

February 1972

AHL, John S. ..... CECOS/EAST
KLAU, Rick ..... NAVSCON Testing Improves Training Methods

Spring 1972

ANDERSON, Richard E. ..... Shore Installation & Facilities Planning
BAER, George E. ..... Interior Design
BARTLETT, James V., RAdm ..... Command Management Plan New Bachelor Enlisted Quarters
BURNS, William F., Cdr. ..... AMMI Lift Dock
CARTER, Frederick J. ..... Construction Battalion Centers
CAVENDISH, L. M. Capt. ..... Construction — A New Direction
CHESDIV Staff ..... Capital Improvements
COPE, R. P. Cdr. ..... Our Nuclear Power Plants
DAUBER, Herbert ..... Professional Personnel Programs
EAGER, Walter J., Cdr. ..... Ocean Engineering
ESSOGLOU, Milton ..... Expeditionary Logistic Facilities
EVANS, Walter S. ..... Innovative Contracting
FAUGHT, W. D. Lt.(jg) ..... Defense Department's Washington Facilities Plan
WELLES, Richard H. ..... Uniform Specifications
GOETZKE, G. A., Capt. ..... Homes for Navy Families
GROFF, J. D., Cdr. ..... $81 Million For Pollution Abatement
HURLEY, Stephen ..... Environmental Data
LEWIS, Bernard T. ..... Maintenance Management For Small Activities
LEWIS, Lois S. ..... Equal Employment Opportunity
LOWE, Robert J. Sr. ..... Ship To Shore Waste Disposal
LOWE, S. D., Cdr. ..... Closing Shop in Vietnam
LOWERY, Richard A., Cdr. ..... Trident, Undersea Long Range Missile System
MAWDSLEY, Norman ..... Mobile Utility Support Equipment
McLAUGHLIN, JOHN C. ..... Care and Repair of Shipyard Cranes
McNEILL, J. E., Cdr. ..... Reorganization of Manpower Management
MORGAN, Frances M. ..... Resources Outlook
O'DONOHUE, Roger ..... Preservation of Historical Sites
PEARSALL, G. H. ..... Personnel Development
POOLE, A. S. LCdr. ..... The ABFC System
ROBINSON, C. F. Cdr. ..... Naval Facilities Data System
STULTZ, Bobby E. Cdr. ..... Self Help Progress
SWANSON, Ernest ..... Impact On Navy Real Estate
TERRILL, Jack W. ..... Disaster Response
THOMAS, George D. ..... Worldwide Inspection of Shipyard Trackage
VIOLETT, Ernest R., Jr. ..... Oil Spillage
WATSON, Peter J., Capt. ..... Military Construction Budget
FIELD, Richard H. ..... Cost Estimating By Computer
WILSON, R. B., Cdr. ..... Naval Construction Force
ZIMMER, Glenn ..... Radiological Precautions
UNSIGNED ..... New NAVFAC Headquarters

Summer 1972

BASS, William M., LCdr. ..... CBMU -302 Stands Down
DRISKO, Richard W. Dr. ..... Cathodic Protection of Moorings
HALL, William M. Ens. ..... Seabees At The Naval Support Activity
VAUDREUIL, W. J. LCdr. ..... Recycling Construction Resources
WHITE, J. L. ..... Modernization At the Naval Academy
UNSIGNED ..... The Seabee Memorial
UNSIGNED ..... RMK-BRJ Closeout in South Vietnam
RINNERT, Henry J. Cdr. ..... Seabees at Naval Support Activity

Fall 1972

JOJOKIAN, Jackson H. ..... The Navy Protects Endangered Species
STEWART, Allen J. LCdr ..... Pollution . . . everyone's problem
UNSIGNED ..... CBC-Davisville Features Community Recycling Program
UNSIGNED ..... NAD McAlester Wins Second Conservation Award
UNSIGNED ..... Navy Restores Penguins' Rookery In Antarctica
UNSIGNED ..... Pearl Harbor Attack On Pollution

Winter 1972

AGNOS, J. N. ..... Antarctic Diesel Power Plant Improved
CRISP, Hugh Cdr. ..... The Navy's Hypervelocity Wind Tunnel
DOEBLER, James LCdr ..... Engineer Registration
GILMORE, G. R. LCdr. ..... Revitalizing A Cambodian Port
GROOVER, Edwin D. EOCS ..... Seabee Overhaul of Nuclear Power Plant
HEFFERNAN, T. J. LCdr ..... ABFC System and Logistics Planning
LEWIS, Bernard T. ..... Planners and Estimator Development
MOODY, Thomas W., LCdr. ..... Power Electronics
NAVFAC Counsel Staff ..... On Advice Of Counsel: Innovative Procurement
PICCO, John J. Lt(jg) ..... Planners and Estimator Development
SPELL, W. H. Lt (jg) ..... The Bolling/Anacostia Master Plan
UNSIGNED ..... A Cleaner Pensacola Bay
UNSIGNED ..... Conservation of Energy
UNSIGNED ..... Quick Camp — Portable Structures
UNSIGNED ..... The Navy Civil Engineer, Readers' Evaluation
UNSIGNED ..... VIBRA-LO . . . Locomotion Is On The Skids

SECOND SECTION

General Features

CBC Davisville Features Community Recycling Program Fall-p.7
Closing Shop In Vietnam ..... Spring-p. 17
Conservation of Energy ..... Winter-p. 19
Construction — A New Direction ..... Spring-p. 17
NAD McAlester Wins Second Conservation Award ..... Fall-p. 7
Navy Civil Engineer, Readers' Evaluation ..... Winter-p. 28
Navy Protects Endangered Species ..... Fall-p. 5
Navy Restores Penguins' Rookery In Antarctica ..... Fall-p. 6
Pearl Harbor Attack On Pollution ..... Fall-p. 4
Pollution . . . everyone's problem ..... Fall-p. 2
RMK-BRJ Closeout in South Vietnam ..... Summer-p. 8
Seabee Memorial ..... Summer-p. 16
Seabees At The Naval Support Activity ..... Summer-p. 21
Young Officer ..... January-p. 2

Construction, Facility

BEQ in '72 ..... Winter-p. 26
Bolling/Anacostia Master Plan ..... Winter-p. 4
Capital Improvements ..... Spring-p. 19
Defense Department's Washington Facilities Plan ..... Spring-p. 21
Homes For Navy Families ..... Spring-p. 30
Interior Design ..... Spring-p. 14
New Bachelor Enlisted Quarters ..... Spring-p. 13
New NAVFAC Headquarters ..... Spring-p. 25
Revitalizing A Cambodian Port ..... Winter-p. 27

Management

ABFC System and Logistics Planning ..... Winter-p. 21
Command Management Plan ..... Spring-p. 5
Cost Estimating By Computer ..... Spring-p. 16
Engineer Registration ..... Winter-p. 11
Equal Employment Opportunity ..... Spring-p. 8
Impact On Navy Real Estate ..... Spring-p. 28
Innovative Contracting ..... Spring-p. 10
Military Construction Budget ..... Spring-p. 34
Naval Facilities Data System ..... Spring-p. 9
Personnel Development ..... Spring-p. 8
Planner and Estimator Development ..... Winter-p. 15
Preservation of Historical Sites ..... Spring-p. 29
Professional Personnel Programs ..... Spring-p. 6
Recycling Construction Resources ..... Summer-p. 18
Reorganization of Manpower Management ..... Spring-p. 7
Resources Outlook ..... Spring-p. 9
Shore Installation & Facilities Planning ..... Spring-p. 34
Uniform Specifications ..... Spring-p. 16
On Advice Of Counsel: Innovative Procurement ..... Winter-p. 20

Schools/Training

CECOS/EAST ..... Spring-p. 2
NAVSCON Testing Improved Training Methods ..... Spring-p. 3

Seabee Features

Self Help Progress ..... Spring-p. 36

Seabee Operations

Antarctic Diesel Power Plant Improved ..... Winter-p. 23
CBMU-302 Stands Down ..... Summer-p. 14
Construction Battalion Centers ..... Spring-p. 36
Expeditionary Logistic Facilities ..... Spring-p. 11
Naval Construction Force ..... Spring-p. 18
Seabee Overhaul of Nuclear Power Plant ..... Winter-p. 22

Technical

ABFC System ..... Spring-p. 27
AMMI Lift Dock ..... Spring-p. 10
Care and Repair of Shipyard Cranes ..... Spring-p. 33
Cathodic Protection of Moorings ..... Summer-p. 27
Pensacola Bay ..... Winter-p. 8
Disaster Response ..... Spring-p. 27
Environmental Data ..... Spring-p. 12
Maintenance Management For Small Activities ..... Spring-p. 31
Mobile Utility Support Equipment ..... Spring-p. 32
Navy's Hypervelocity Wind Tunnel ..... Winter-p. 24
Ocean Engineering ..... Spring-p. 35
Oil Spillage ..... Spring-p. 12
Our Nuclear Power Plants ..... Spring-p. 15
Power Electronics ..... Winter-p. 9
Quick Camp Portable Structures ..... Winter-p. 14
Radiological Precautions ..... Spring-p. 16
Ship To Shore Waste Disposal ..... Spring-p. 12
Undersea Long Range Missile System ..... Spring-p. 26
VIBRA-LO . . . Locomotion Is On The Skids ..... Winter-p. 7
Worldwide Inspection of Shipyard Trackage ..... Spring-p. 33
$81 Million For Pollution Abatement ..... Spring-p. 35

CHANGE OF ADDRESS

To insure prompt and correct delivery of *The Navy Civil Engineer* please return the *mailing label* and your corrected address to the agency indicated: For Individual Active Duty Officers send to:

Naval Facilities Engineering Command
Attn: Code 09M1
Washington, D.C., 20930

For Individual Inactive Reserve Officers send to:

Naval Reserve Manpower Center
Attn: Code 02
Bainbridge, Md., 21905

For paid subscribers, please send change to:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20401

For all others (organizations, offices, etc) send to:

The Navy Civil Engineer (Code 22M)
Naval Construction Battalion Center
Port Hueneme, Calif., 93043

PEACE
PROGRESS
PROSPERITY

Our wish for 1973

U.S. GOVERNMENT PRINTING OFFICE : 1972 789-289 50503